

1.11.2

EPA WORK ASSIGNMENT NUMBER: 132-1L46
EPA CONTRACT NUMBER: 68-01-7250
EBASCO SERVICES INCORPORATED

SUPERFUND RECORDS CTR	_____
Site:	<u>Wells G&H</u>
Break:	<u>3.5</u>
Other:	<u>#16803</u>

FINAL
SUPPLEMENTAL REMEDIAL
INVESTIGATION FOR
FEASIBILITY STUDY
WELLS G&H SITE
WOBURN, MASSACHUSETTS

DECEMBER, 1988

NOTICE

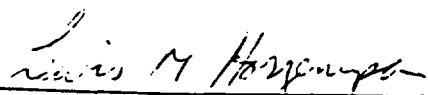
THE INFORMATION IN THIS DOCUMENT HAS BEEN FUNDED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA) UNDER REM III CONTRACT NO. 68-01-7250 to EBASCO SERVICES, INC. (EBASCO). THIS DOCUMENT HAS BEEN FORMALLY RELEASED BY EBASCO TO USEPA. THIS DOCUMENT DOES NOT REPRESENT, HOWEVER, THE USEPA POSITION OR POLICY, AND HAS NOT BEEN FORMALLY RELEASED BY USEPA.

EPA WORK ASSIGNMENT NUMBER: 132-1L46
EPA CONTRACT NUMBER: 68-01-7250
EBASCO SERVICES INCORPORATED

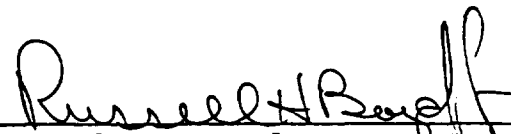
FINAL
SUPPLEMENTAL REMEDIAL
INVESTIGATION FOR
FEASIBILITY STUDY
WELLS G&H SITE
WOBURN, MASSACHUSETTS

DECEMBER, 1988

PREPARED BY:


Lewis M. Horzempa, Ph.D.
Site Manager
Ebasco Services Incorporated

APPROVED BY:


Russell H. Boyd, Jr. P.E.
Regional Manager, Region I
Ebasco Services Incorporated

7132b

TABLE OF CONTENTS
SUPPLEMENTAL RI RESULTS

<u>Section</u>	<u>Title</u>	<u>Page No.</u>
1.0	INTRODUCTION	1
1.1	Site Description	1
1.2	Objectives	1
2.0	INITIAL ACTIVITIES	5
2.1	Existing Data Review and Summary	5
2.2	Access, Rights of Entry and Other Authorization Requirements	5
2.3	Procurement of Subcontractors	5
2.4	Mobilization	5
3.0	SAMPLING ACTIVITIES	7
3.1	Soil Gas	7
3.2	Surface Water/Sediment	9
3.3	Sewer Composites	9
3.4	Surface Soils	9
3.5	Sludge	9
3.6	Subsurface Soil	10
3.7	Monitoring Well Installations	10
3.8	Groundwater	10
3.9	Technical Oversight Services	11
3.10	Sample Preparation and Handling	12
3.11	Final Survey	12
3.12	Demobilization	12
4.0	PROPERTY SPECIFIC SAMPLING ACTIVITIES	13
4.1	Olympia Nominee Trust	13
4.2	W.R. Grace and Company	18
4.3	Wildwood Conservation Corporation	21
4.4	New England Plastics Company	25
4.5	Central Area	28
4.6	Unifirst Corporation	34
4.7	Groundwater Treatability Study	34
5.0	RESULTS OF RI SAMPLING ACTIVITIES	35
5.1	Olympia Nominee Trust	35
5.2	W. R. Grace and Company	42
5.3	Wildwood Conservation Corporation	46
5.4	New England Plastics	51
5.5	Unifirst Corporation	53
5.6	Central Area	57
5.7	Air	63
5.8	Summary of Groundwater Treatability Study	63
5.9	Field Blanks and Trip Blanks	64
5.10	Fate and Transport of Groundwater Contaminants	64

TABLE OF CONTENTS (Cont'd)

SUPPLEMENTAL RI RESULTS

<u>Section</u>	<u>Title</u>	<u>Page No.</u>
6.0	SUMMARY OF INVESTIGATIVE FINDINGS	67
6.1	Olympia Nominee Trust	67
6.2	W. R. Grace and Company	67
6.3	Wildwood Conservation	68
6.4	New England Plastics	69
6.5	Central Area	69
6.6	Unifirst Corporation	70
6.7	Conclusions	70

REFERENCES

APPENDICES

Appendix A	Tabulation of Samples Collected
Appendix B	Boring Logs, Monitoring Well Construction Diagrams
Appendix C	Survey Coordinates
Appendix D	Groundwater Treatability Study Report
Appendix E	Analytical Sample Results
Appendix F	Unifirst Boring Logs

LIST OF TABLES
SUPPLEMENTAL RI RESULTS

<u>Table No.</u>	<u>Title</u>	<u>Page No.</u>
3-1	Summary of Samples Collected	8
5-1	Approximate Soil Gas Analysis Results	36
5-2	Summary of Maximum Contaminant Concentrations in Soils (1987 Data)	37
5-3	Summary of Maximum Organic Contaminant Concentrations in Groundwater (1987 Data)	38

LIST OF FIGURES
SUPPLEMENTAL RI RESULTS

<u>Figure No.</u>	<u>Title</u>	<u>Page No.</u>
1-1	Location and Approximate Boundaries of the Wells G&H Site	2
1-2	Site Map for Wells G&H, Woburn, MA	3
4-1	Olympia Property Soil Gas Sampling Locations	14
4-2	Olympia Property Soil Sampling Locations	15
4-3	Supplemental RI Groundwater Sampling Locations at the Wells G&H Site	17
4-4	W.R. Grace Property Soil Gas Sampling Locations	19
4-5	W.R. Grace Property Soil Boring and Surface Water Sediment Locations	20
4-6	Wildwood Property Soil Gas Sampling Locations	22
4-7	Wildwood Property Soil and Sludge Sample Locations	23
4-8	New England Plastics Property Soil Gas Sampling Locations	26
4-9	New England Plastics Soil Sampling Locations	27
4-10	Phase I Surface Water and Sediment Sampling Locations at the Wells G&H Site	29
4-11	Approximate Locations of Phase II Sediment Samples Collected During June 1988	31
4-12	Sewer Composite and Central Area Surface Soil Sampling Locations	32
5-1	Representative Olympia Property Soil Concentrations (ug/kg)	39
5-2	Olympia Property Groundwater Elevations-1987	41

LIST OF FIGURES (Cont'd)

SUPPLEMENTAL RI RESULTS

<u>Figure No.</u>	<u>Title</u>	<u>Page No.</u>
5-3	Locations of Elevated TCE Soil Gas Level (ul/l) At W.R. Grace	43
5-4	W.R. Grace Property Soil Concentrations (ug/kg)	44
5-5	Locations of Elevated TCE Soil Gas Levels (ul/l) at Wildwood Conservation Corporation	47
5-6	Representative Wildwood Soil Concentrations (ug/kg)	48
5-7	New England Plastics Property Concentrations (ug/kg)	52
5-8	New England Plastics Property Groundwater Elevations - 1987	54
5-9	Unifirst Property Well Locations	55
5-10	Central Area (Rifle Range) Surface Soil Concentrations (ug/kg)	60
5-11	Elevation of Groundwater in the Vicinity of the Wells G&H Site October - December, 1987	62
5-12	Comparison of 1985 and 1987 Groundwater Contaminant Concentrations (ug/l)	66
Plate 1	Monitoring Well Locations	See Plastic Pocket
Plate 2	Volatile Organic Concentrations in Groundwater	

1.0 INTRODUCTION

1.1 Site Description

The Wells G&H site is located in the City of Woburn, approximately 10 miles north of the City of Boston, Massachusetts. The site location and boundary is shown in Figure 1-1. The site is the aquifer area that affects the wellfield of Wells G&H and lies within State Route 128 (Interstate Route 95) Route 93, Salem Street, and the B&M Railroad tracks. The site land use is highly developed with light commercial and light industrial parks bordering the wetlands area associated with the Aberjona River floodplain. The site is approximately 330 acres.

Figure 1-2 shows the location of Wells G&H relative to the various individual properties included in the Supplemental RI, including: W.R. Grace Company, Unifirst Corporation, Olympia Nominee Trust, Wildwood Conservation Corporation, and New England Plastics.

The Aberjona River flows north to south through the center of the site and splits into two channels south of Olympia Avenue. The two channels converge approximately 1,000 feet downstream again, forming a single channel. The areas to the east, west and south of the site are dominated by residential developments. Industriplex, a 244 acre industrial park, is located to the north. There is a significant wetlands area associated with the Aberjona River in the southwest quadrant of the site. Groundwater flows from the east and west portions of the study area toward the river valley and then to the south. The surface elevations at the site rise rapidly on both sides of the river valley. The surface configuration reflects the underlying bedrock surface. A fault extends north-south under the Aberjona River Valley. Many bedrock outcrops are present in the highlands to the east of the valley.

1.2 Objectives

The purpose of the Supplemental Remedial Investigation (RI) at the Wells G&H site was to support and expand upon the Part I RI conducted by NUS (1984-1985) and the Part II RI conducted by PRC Engineering (1986), and to provide the data needed for the Feasibility Study. In summary, the primary objectives were to:

- o Delineate the extent of soil contamination at the source areas.
- o Obtain current hydrogeologic and groundwater contamination data to define the present extent of groundwater contamination at the site.
- o Develop information on surface water and sediments to support the environmental impact evaluation of alternatives, the Endangerment Assessment, and the Wetlands Assessment.
- o Complete a comprehensive site characterization to support the Feasibility Study.

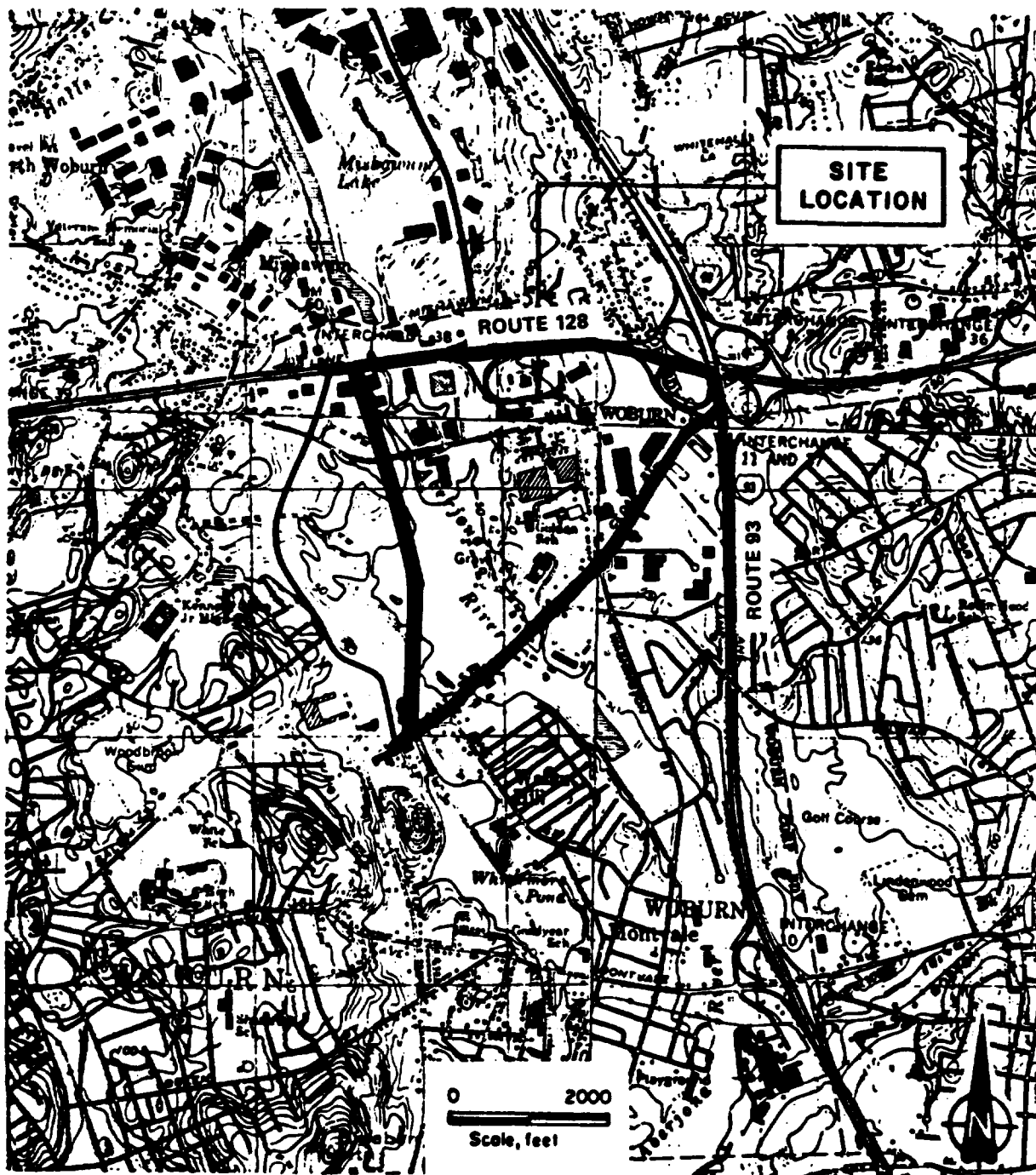
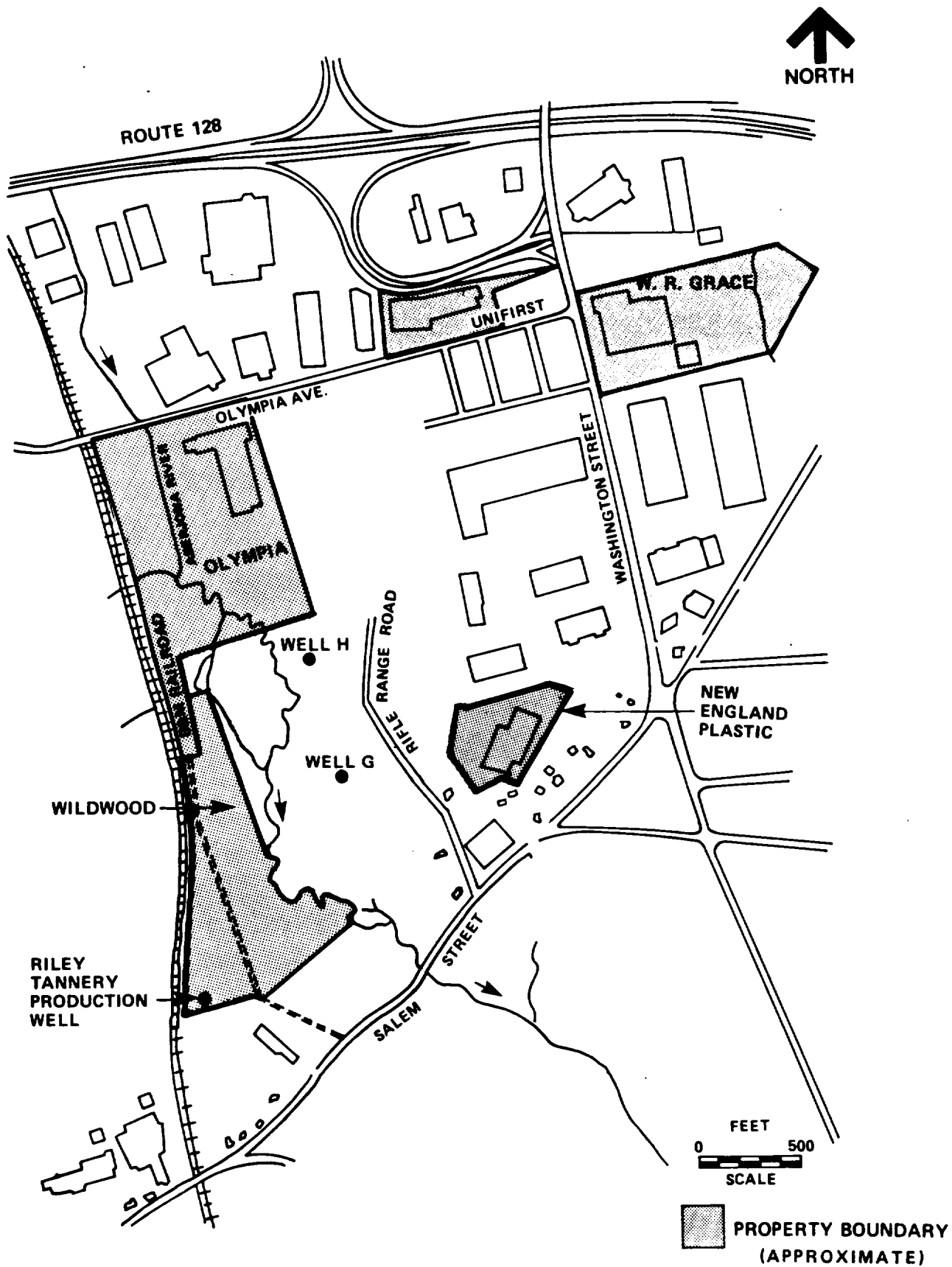


FIGURE 1-1 LOCATION AND APPROXIMATE BOUNDARIES OF THE WELLS G&H SITE. SOURCE: U.S.G.S. 7.5' LEXINGTON, READING, WILMINGTON AND BOSTON NORTH QUADRANGLES.

MAP SOURCE:
ATC WETLANDS ASSESSMENT
WELLS G&H SITE
MARCH, 1986

FIGURE 1-2
SITE MAP FOR THE WELLS G & H SITE
WOBURN, MA



This report presents a compilation of information and sampling results obtained from the Supplemental RI field studies and certain other remedial investigations conducted at the site. However, the intent of this report is not to present a complete summary of all previous RI activities at the Wells G&H Site. Instead, the reader is referred to the previous RI reports mentioned above for more detail on site background information, history, geology, hydrogeology and contamination.

Subsequent to the Part I RI (NUS, 1986), EPA contracted the United States Geological Survey (USGS) to design and perform an aquifer pumping test that would provide data on the area of influence and zone of contribution of Wells G&H. The USGS published the results of their study in 1987 (USGS, 1987).

The USGS aquifer test (USGS, 1987) concluded that Wells G&H obtain water from an area of aquifer, or zone of contribution, that may be divided into two parts. Most water pumped by the wells is obtained from that part of the aquifer immediately surrounding both wells and from induced infiltration of surface water from the overlying river and wetland. Water also is obtained from a small area south of the wells, and a limit can be determined which marks the dividing line between the area in which ground water flows toward well G and the area in which ground water flows southward toward the river and toward the Riley well. The Riley well pumps groundwater to the Riley tannery for use as process water. The remaining part of the zone of contribution is that area of the Aberjona River drainage basin upgradient from and outside of the area of influence of Wells G&H. A small amount of surface water in the river entering the northern end of the study area, which is derived from ground water discharge and surface water runoff in the upgradient drainage area, is induced from the river to the wells under pumping conditions.

The size of the area south of Wells G&H that contributes water to the wells is variable and depends on the pumping rates of Wells G&H, on the rate and schedule of pumping of the Riley well, and on hydrologic conditions.

For purposes of this Supplemental RI reference to locations of contamination is done in terms of property ownership and is not meant to delineate liability for purposes of the Comprehensive Environmental Response Compensation & Liability Act, as amended.

The remainder of this Supplemental RI is organized as follows:

Section 2.0 discusses the initial activities prior to sampling. Section 3.0 discusses the general sampling activities and techniques while Section 4.0 discusses the specific sampling activities conducted at each of the individual properties located within the Wells G&H site. Section 5.0 presents the sampling results and Section 6.0 discusses the summary and conclusions relating to each property and the site in general.

2.0 INITIAL ACTIVITIES

2.1 Existing Data Review and Summary

In order to direct the Supplemental Remedial Investigation and avoid duplication of effort, a review of existing data was conducted during the scoping of the field investigation. The available data were evaluated to determine what type(s) of additional sampling, if any, would be required. There is a significant body of information available regarding the Wells G&H study area. However, based on a review of the existing data and discussions with EPA personnel at the scoping meeting, it was determined that additional sampling was necessary to resolve certain existing data gaps and to provide input for the Feasibility Study.

2.2 Access, Rights of Entry and Other Authorization Requirements

Access to the Wells G&H site and associated properties on which work was conducted by EBASCO was obtained by EPA prior to the initiation of field activities. Permission to conduct RI activities and on-site treatability studies, rights of entry, utility easements, and other authorizations such as access to existing wells, were secured by EPA.

2.3 Procurement of Subcontractors

As part of the field investigations, subcontracts were procured by EBASCO for soil boring/monitoring well drilling, treatability testing and surveying services. Specifications for drilling, treatability testing, and surveying were developed and sent out for competitive bids and subcontractors were selected to perform the work. Drilling was subcontracted to Layne Northern Company of Schenectady, New York, surveying was subcontracted to C.T. Male Associates of Latham, New York and the on-site treatability testing was subcontracted to Environmental Science and Engineering of Gainesville, Florida.

2.4 Mobilization

This subtask included field personnel orientation, equipment mobilization, and initial site reconnaissance which was performed at the initiation of the field activities. A field team orientation meeting was held prior to the initiation of sampling to familiarize personnel with the site history, health and safety requirements, and field procedures.

Equipment mobilization included, but was not limited to, the setup of the following equipment:

- o Field office trailer (command post);

- o Sampling equipment;
- o Health and Safety and decontamination equipment;
- o Utility hook-ups; and
- o Drilling subcontractor equipment.

As part of the initial site reconnaissance, preliminary sampling locations were staked in the field. These locations were measured from existing landmarks. Provisions were taken to accommodate ongoing manufacturing operations and sampling activities at existing private facilities and properties. An existing office trailer located north of the Wells G&H site on Commerce Way, used by EPA previously for the Industri-plex site, was used as the command post and base of operations for the Supplemental RI. Field activities were conducted at the site during the period from September 1987 through January 1988. Limited additional sampling was also conducted in June 1988.

3.0 SAMPLING ACTIVITIES

The field activities and media sampling for the Supplemental RI included the following: soil gas surveys, surface water/sediment sampling; sewer composite sampling, surface soil sampling, sludge sampling, subsurface soil sampling, monitoring well installations, groundwater sampling, and technical oversight of sampling activities conducted at the Unifirst property by their consultant. A total of 366 samples (including QA/QC samples) were collected during the Supplemental RI (Table 3-1). A complete tabulation of all the samples collected, their case numbers, traffic report numbers, date sampled, and chemical analyses performed is presented in Table A-1, Appendix A.

Most of the samples which were collected were submitted to the EPA Contract Laboratory Program (CLP) for analysis of Target Compound List (TCL) volatile organics or alternately full TCL analyses. Certain samples, however, were tested for other constituents such as dioxin, radionuclides, or conventional parameters. Table A-2, Appendix A contains a list of each TCL analytical group, the analytes, and their critical detection limits.

3.1 Soil Gas

Soil gas surveys were conducted by EBASCO as a screening tool to help identify the present extent of subsurface volatile organic soil contamination through the analysis of selected indicator volatile organics in the subsurface media. This method was used to characterize source areas of contamination at specific properties to aid in the selection of subsurface soil sampling locations. Initially, a course grid (100' intervals) was used to establish background information on concentration levels, while a finer grid spacing (40') was used in suspect areas. The suspect areas generally represented locations of previous surface and subsurface disposal activities, and zones of excessive groundwater contamination or zones in which high soil gas readings were initially obtained.

Compounds analyzed during the soil gas surveys included trichloroethene, dichloroethene and tetrachloroethene. These compounds were previously identified in the groundwater and soil at the various source areas. The soil gas surveys were used to delineate associated soil source areas for these compounds, and therefore, aid the proposed subsurface soil sampling program.

The soil gas surveys involved drilling a hole approximately 3 feet deep into the soil using either a hand auger or rotary hammer. A hand held PVC probe, slightly smaller in diameter than the borehole, was then inserted into the subsurface to a depth of 3 feet. Soil gas was drawn from the subsurface by a vacuum pump connected to the end of the probe by a two-to-three foot piece of tubing. The gas sample was then withdrawn from the tubing with a gas-tight syringe and injected for analysis into a portable gas chromatograph, equipped with a photoionization detector (Photovac Model 10S50).

TABLE 3-1
SUMMARY OF SAMPLES COLLECTED

SAMPLE LOCATION	SUBSURFACE SOILS		GROUNDWATER	SLUDGE	SURFACE WATER	SEDIMENT	SURFACE SOIL	SEWER
	BORINGS	WELLS						
W.R. GRACE	18	-	24	-	1	1	-	-
WILDWOOD	34	-	17	11	-	-	12	1
OLYMPIA	23	9	14	-	-	-	8	1
N.E. PLASTICS	7	7	9	-	-	-	5	-
UNIFIRST	-	-	11	-	-	-	-	-
CENTRAL AREA	-	4	37	-	9	32	2	-
Subtotal	82	20	112	11	10	33	27	2
Field Blanks	Taken: 27							
Trip Blanks	Taken: 41							
D.I. Blanks	Taken: 1							

Total Samples Collected: 366

3.2 Surface Water/Sediment

To support the Wetlands Assessment and Endangerment Assessment, surface water and sediment samples were collected along the Aberjona River and its tributaries, and in some drainage ditches feeding the river. These samples were collected to determine the extent of contamination in the surface water and sediment throughout the Wells G&H site. Surface water flow rates were measured upstream and downstream of the site during the sample collection period. In addition, pH, conductivity and temperature were recorded at the time of surface water sample collection.

The sediment samples were collected using a stainless steel sediment corer which was hand lowered to the river bed. Some samples were also taken using a hand held trowel in areas where the sediment contained primarily sand and gravel which could not be retained in the sediment corer.

Surface water samples were obtained by submersing the sample bottles in the river at the sampling locations.

3.3 Sewer Composites

Composite sewer samples were taken from the City of Woburn and Massachusetts Water Resource Authority (MWRA) sewers to evaluate the potential effects from surcharging and overflow reported to occur at some of the manholes. The samples were used to determine whether chemical contaminants are present in the wastewater flowing through the sewer. An automatic sampling device (ISCO Model 2100) was used to collect a composite sample of discrete grab samples taken at 15 minute intervals over a 24 hour period. In addition, grab samples were collected for volatile organics analysis.

3.4 Surface Soils

Surface soil samples were collected to evaluate surface soil conditions at suspect spill areas and at locations adjacent to some of the sewer manholes to investigate potential soil contamination from any sewer surcharging and overflow at these manhole locations. The surface soil samples were taken from depths of 0-1 feet using a hand auger.

3.5 Sludge

Sludge samples were taken from suspected and observed waste area locations previously mapped on the Wildwood Conservation Corporation property. Analytical testing and characterization of these areas was conducted for source delineation purposes. The samples were taken using a stainless steel trowel.

3.6 Subsurface Soil

Based on the results of the soil gas surveys and visual observations of site contaminant conditions, subsurface soil boring locations were identified. The primary purpose of the boring programs was to delineate the horizontal and vertical extent of soil contamination at the various source areas so that the soil volume requiring remediation in each site area could be determined for the Feasibility Study.

Continuous split-spoon soil sampling was conducted in each boring for soil classification purposes. Boring logs of the soil boreholes are presented in Appendix B. Generally, two soil samples were collected for laboratory analysis from the unsaturated zone at each boring location. Analytical samples were selected for analysis based on visual observations and OVA headspace screening analysis. At locations where only two samples could be collected (due to shallow groundwater conditions) both samples were sent for analytical testing. All borings were completed using a truck mounted rig with hollow stem augers or a tripod rig.

3.7 Monitoring Well Installations

Due to the extensive network of existing monitoring wells throughout the Wells G&H site, only nine additional wells were installed. The new wells were installed at the Olympia Nominee Trust, New England Plastics and Aberjona Auto Parts Properties.

The monitoring wells were drilled using hollow stem augers. The wells were completed at varying depths ranging from 10 to 30 feet to permit the investigation of shallow groundwater contamination in areas which were previously not studied. Continuous split spoon soil sampling was conducted above the water table and at five foot intervals in the saturated zone for soil classification purposes. Boring logs and construction diagrams for the monitoring wells are presented in Appendix B. Two subsurface split-spoon soil samples were obtained from the unsaturated zone at each well location for analytical testing. As specified in the Field Operations Plan, the wells were screened below the water table to evaluate shallow groundwater conditions and constructed of two inch diameter PVC riser with PVC well screens.

Upon completion of well installation, the wells were developed by pumping and surging. Development of each well lasted for at least one hour depending on site conditions. Specific conductance, temperature and pH were monitored during well development.

3.8 Groundwater

One round of groundwater samples was collected from selected existing wells located throughout the site area and the nine new wells installed during the Supplemental RI. At certain well

locations, a second supplemental sampling round was conducted in June 1988 with samples analyzed for heavy metals only. The samples were collected to spatially characterize groundwater quality and determine the present extent of contamination. The sampling results were also intended to provide an indication of contaminant fate and transport trends. The majority of the groundwater samples were collected from wells located adjacent to soil sampling locations at or adjacent to the source areas. The Central Area well samples were taken to evaluate the existing groundwater contamination conditions in close proximity to Wells G&H.

Prior to sampling, a minimum of three well volumes of groundwater were evacuated from each well. The wells were purged using a centrifugal pump or bailer and sampled with a stainless steel or teflon bailer. The bailer and appurtenant downhole equipment were decontaminated prior to each use. Specific conductance, temperature and pH were monitored during pre-sample purging. Steady-state values of these parameters are tabulated in Table A-3, Appendix A.

3.9 Technical Oversight Services

Simultaneously with Ebasco's Supplemental RI activities, drilling and sampling activities were also conducted at the Unifirst property by the property owners' consultant, Environmental Research and Technology Inc. (ERT). Wells were installed both on the Unifirst property and to the south of the property to determine the extent of contaminant migration. EPA provided technical oversight of the drilling and sampling activities on the Unifirst property.

In addition, technical oversight services were provided by EBASCO during groundwater sampling activities conducted by the consultant (ERT) to Unifirst Corporation at two Central Area well locations. These wells were installed to monitor bedrock groundwater quality conditions downgradient of the Unifirst property. Multiple port sampling devices were installed at varying depths in these wells for groundwater sampling purposes. EPA's on-site representative (EBASCO) determined, with appropriate EPA approval, the amount and depths of the analytical samples that were collected by Unifirst Corporation's consultant for analysis by EBASCO/EPA.

In addition, the EPA on-site representative documented all field procedures and techniques used during the field activities and media sampling event. The groundwater samples were collected by Unifirst Corporation's consultant and transferred to Ebasco. The samples were submitted to the EPA Contract Laboratory Program (CLP) for analysis.

3.10 Sample Preparation and Handling

All sampling conducted by EBASCO, including the sample collection, preservation, and shipping of samples, was conducted in accordance with EPA and CLP guidelines. In addition, information pertaining to the handling of all sample types was documented on the required forms, as stipulated by EPA and CLP. Data analysis was performed by certified CLP laboratories and validated according to CLP protocol, USEPA Region I.

3.11 Final Survey

Upon completion of the field operations, final sampling locations were established by a Licensed Land Surveyor and precise locations were plotted on existing site topographic survey maps. Items located included soil gas survey nodes, subsurface soil borings, new monitoring wells, and surface water/sediment, sludge, surface soil and sewer composite sample locations. A tabulation of all surveying data, including horizontal coordinates and elevations is presented in Table C-1, Appendix C.

3.12 Demobilization

This subtask consisted of equipment demobilization and was performed at the completion of field activities.

Equipment demobilization included the following items:

- o Field office trailer (command post);
- o Drilling subcontractor equipment;
- o Sampling equipment;
- o Health and safety and decontamination equipment; and
- o Utility hook-ups

4.0 PROPERTY SPECIFIC SAMPLING ACTIVITIES

4.1 Olympia Nominee Trust

Soil Gas

The soil gas survey conducted at the Olympia Nominee Trust property included 37 sampling nodes concentrated west of the Aberjona River as shown in Figure 4-1. These locations were chosen to investigate previous surface or subsurface disposal activities which may have impacted this area of the site. The soil gas survey sampling grid interval was established with 40 and 100 foot spacings with the sampling depth set at approximately three feet. A few locations were separated by shorter distances (i.e. 10-20 feet) in areas of suspected positive readings.

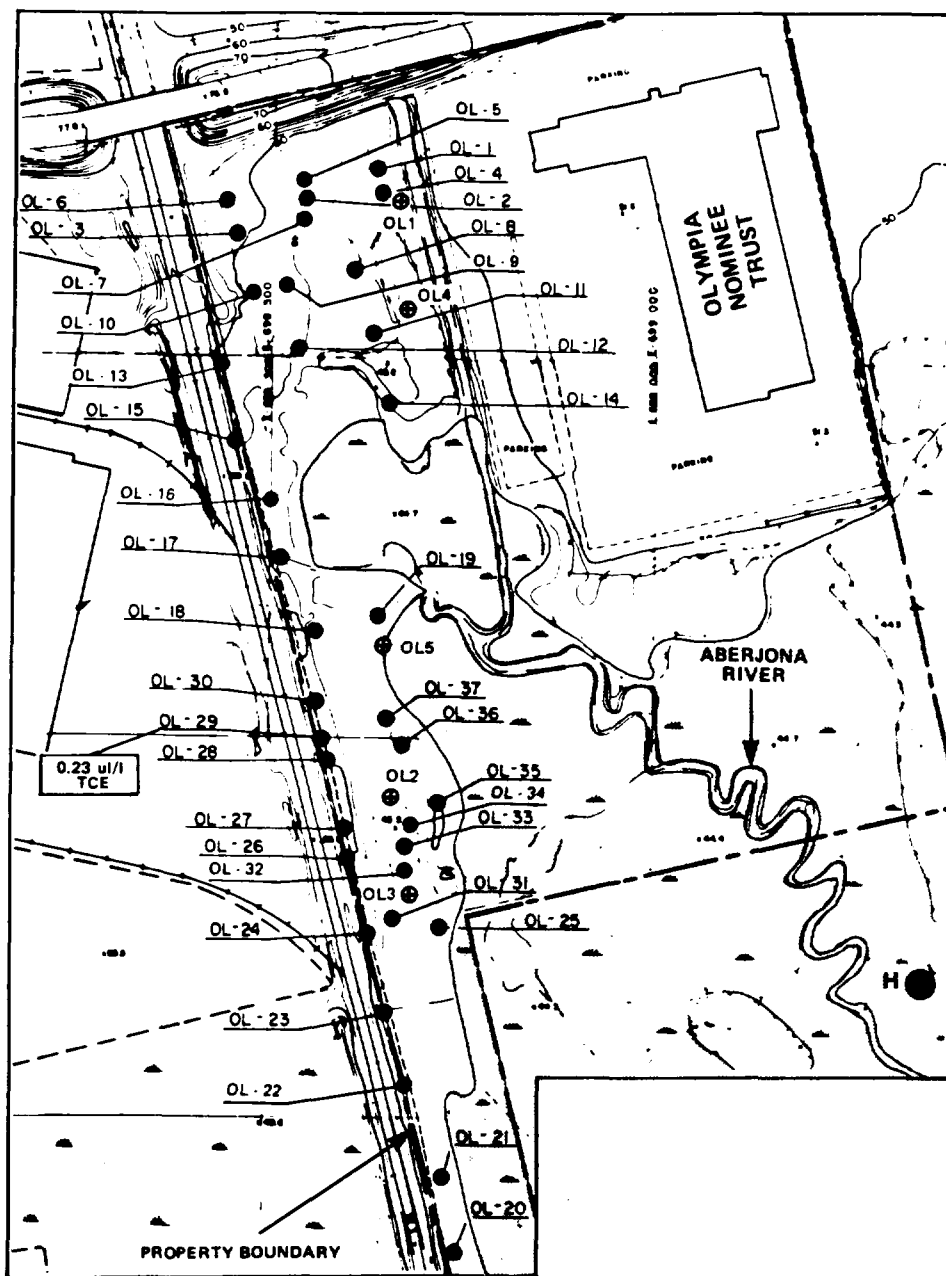
Surface Soils

Five surface soil samples (four discrete samples and one duplicate) were obtained from the Olympia Nominee Trust property using a hand auger. Samples were collected adjacent to the City of Woburn sewer manholes and the MWRA sewer manholes (Figure 4-2). The surface soil samples were collected to evaluate the potential effect of sewer surcharging reported to have occurred at these manholes. These samples were analyzed for the full TCL list of compounds.

Three additional surface soil samples (SS-14, SS-15, SS-16) were collected from the west-central portion of the Olympia Nominee Trust property for dioxin analysis. Samples were obtained using a hand-held trowel. All surface soil sample locations are shown in Figure 4-2.

Subsurface Soil Borings and Sampling

Based on the results of the soil gas survey and visual observations of contaminant conditions, ten boring locations were identified and subsurface soil sampling was conducted to quantify potential soil contaminant conditions. Soil boring locations are shown in Figure 4-2. The subsurface soil data were also used for comparison with groundwater quality data from nearby monitoring wells. The soil borings were completed using a CME-55 drill rig (hollow stem auger method) and a tripod rig. Continuous split-spoon samples were collected from all borings for classification purposes. Approximately two soil samples were obtained for laboratory analysis from the unsaturated zone at each boring location. Analytical sample selection was based on field observations and OVA headspace screening results. Due to the lack of existing subsurface soil data at the Olympia property all 23 samples were analyzed for full Target Compound List (TCL) parameters.



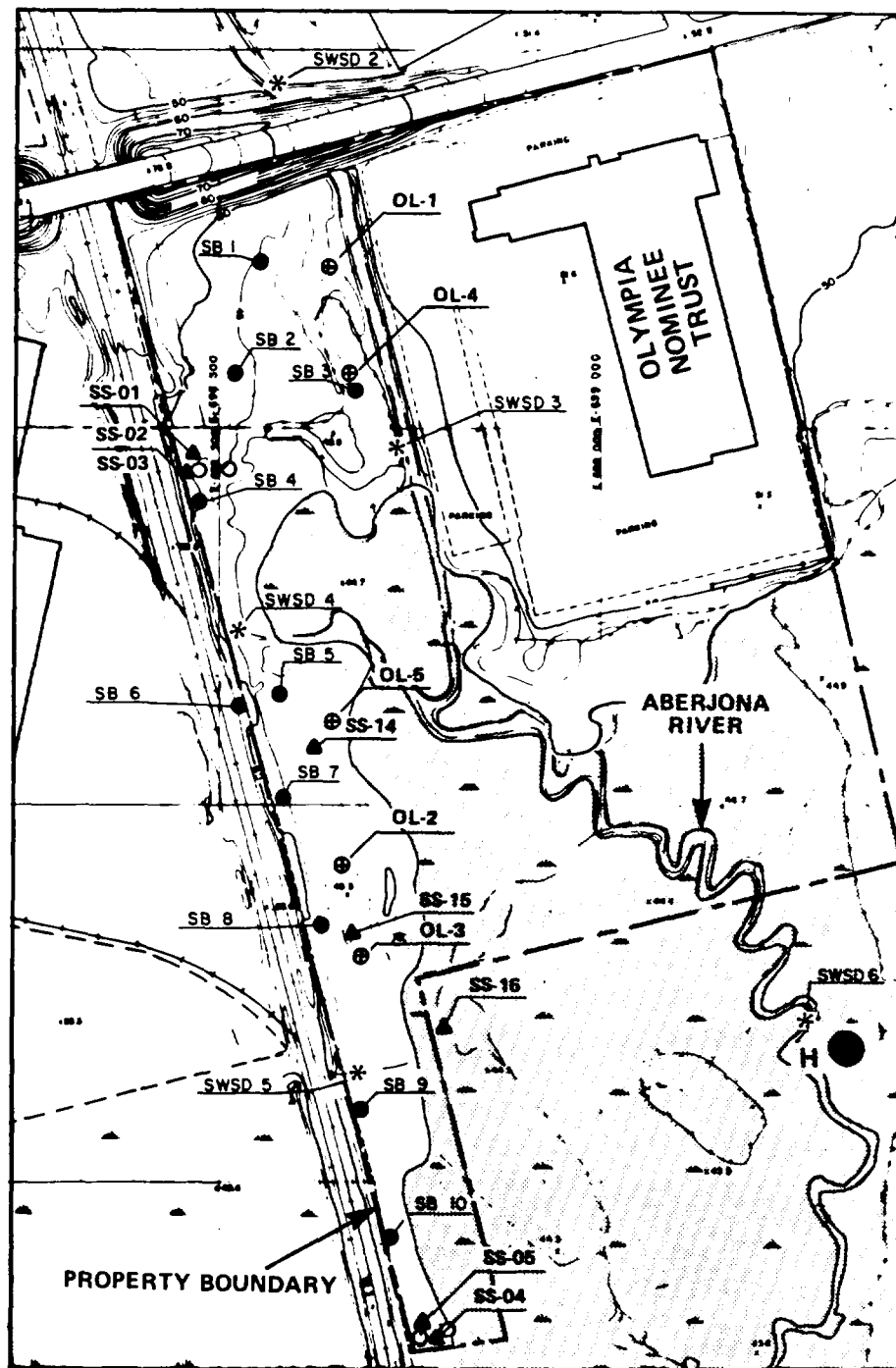
NOTE: ● OL-1 - SOIL GAS SAMPLING LOCATION

⊕ OL-2 - WELL LOCATION
 □ WETLANDS

U.S. ENVIRONMENTAL
 PROTECTION AGENCY

WELLS G & H

FIGURE 4-1
 OLYMPIA PROPERTY
 SOIL GAS SAMPLING LOCATIONS



100 0 100 200 300 FEET

- SB1 - SOIL BORING LOCATION AND NUMBER
- ⊙ OL-1 - WELL BORING LOCATION AND NUMBER
- ▲ SS-01 - SURFACE SOIL LOCATION AND NUMBER
- * SWSD3 - SURFACE WATER SEDIMENT LOCATION AND NUMBER

--- PROPERTY BOUNDARY

OO APPROXIMATE SEWER MANHOLE LOCATIONS

□ WETLANDS

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 4-2

OLYMPIA PROPERTY
SOIL SAMPLING LOCATIONS

EBASCO SERVICES INCORPORATED

All subsurface borings at the Olympia Nominee Trust property were terminated at a depth of approximately six feet below grade which was the average depth to groundwater.

Monitoring Well Installations

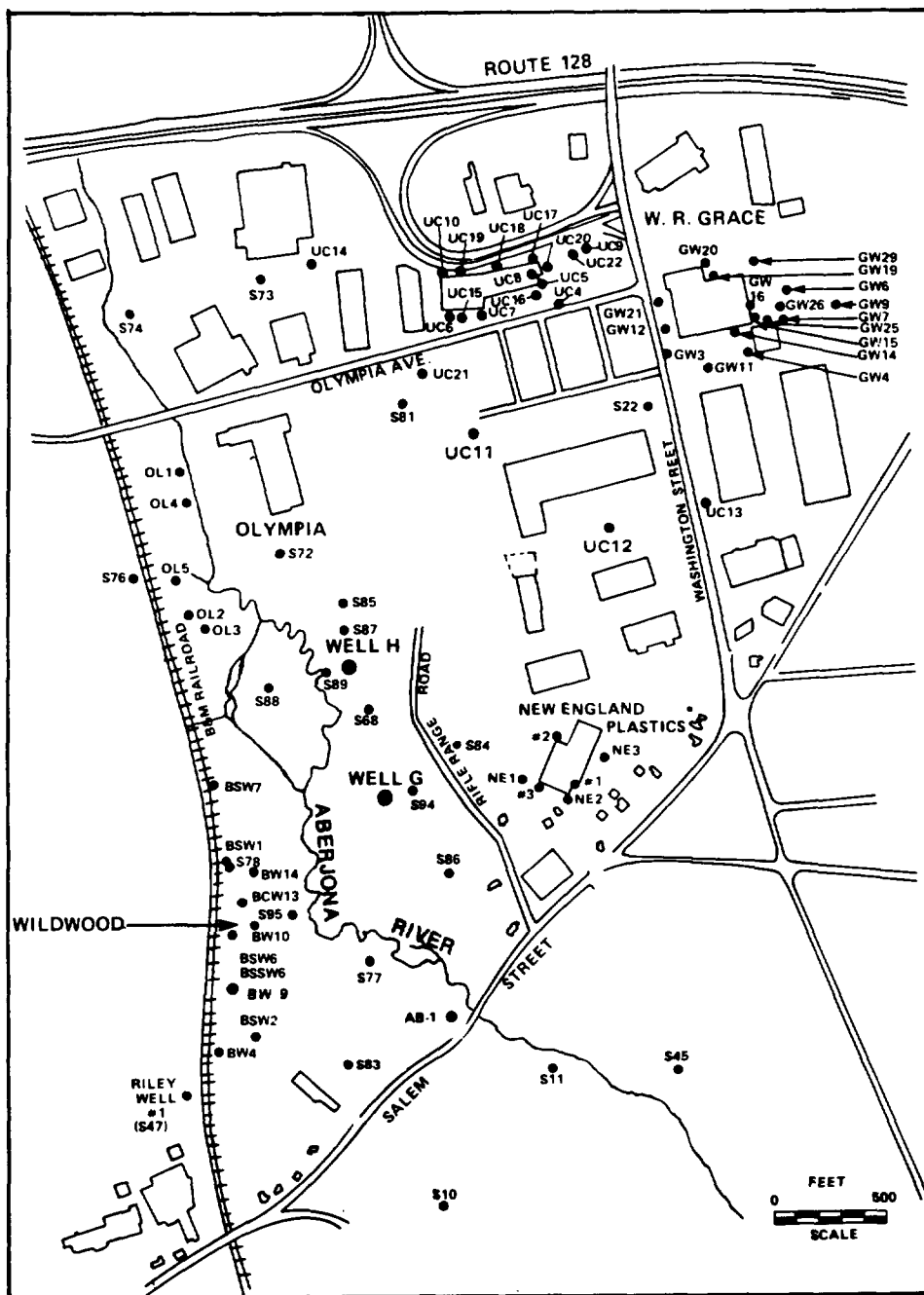
A total of five monitoring wells (OL1 through OL5) were installed on the Olympia Nominee Trust property to provide additional subsurface soil chemical and groundwater quality data which were lacking in this area of the Wells G&H site. The monitoring wells were drilled with a CME-55 drill rig using the hollow stem auger method to depths ranging from ten to thirty-one feet. All of the wells were placed on the western side of the property as shown in Figure 4-3. Monitoring well locations were based on soil gas survey results and visual observations of surface contaminant conditions. Continuous split-spoon samples were collected from all monitoring well boreholes down to the water table. Below the water table split spoon samples were collected at five foot intervals. A maximum of two soil samples were obtained for analytical laboratory testing from the unsaturated zone at each well location. Analytical sample selection was based on field observations and OVA headspace screening results.

All monitoring well soil samples (total of nine) were tested for the full TCL compounds.

Groundwater

One round of groundwater samples was obtained from the five newly installed monitoring wells (OL1 through OL5) and from existing wells S72 and S76 (Plate 1 and Figure 4-3). Upgradient and middle property area groundwater conditions were characterized by investigations at wells OL1 and OL4, respectively. Existing well S76 was used to monitor groundwater quality upgradient of the Olympia property. In addition, groundwater data from S76 was compared with soil data from soil borings SB7 and SB8. Wells OL2, OL3 and OL5 were installed to monitor groundwater conditions adjacent to the former drum disposal areas identified previously at this property. Well S72 was sampled to update groundwater quality information adjacent to the trucking facility portion of this property on the east side of the Aberjona River. All groundwater samples received full TCL analyses due to the lack of existing groundwater quality data at this property.

It should also be noted that certain wells (OL-1, OL-2 and OL-3) were resampled in June 1988 for TCL inorganics only. Well OL-4 was also resampled for TCL volatile organics.



U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 4-3
SUPPLEMENTAL RI GROUNDWATER SAMPLING
LOCATIONS AT THE WELLS G&H SITE

EBASCO SERVICES INCORPORATED

4.2 W.R. Grace & Company

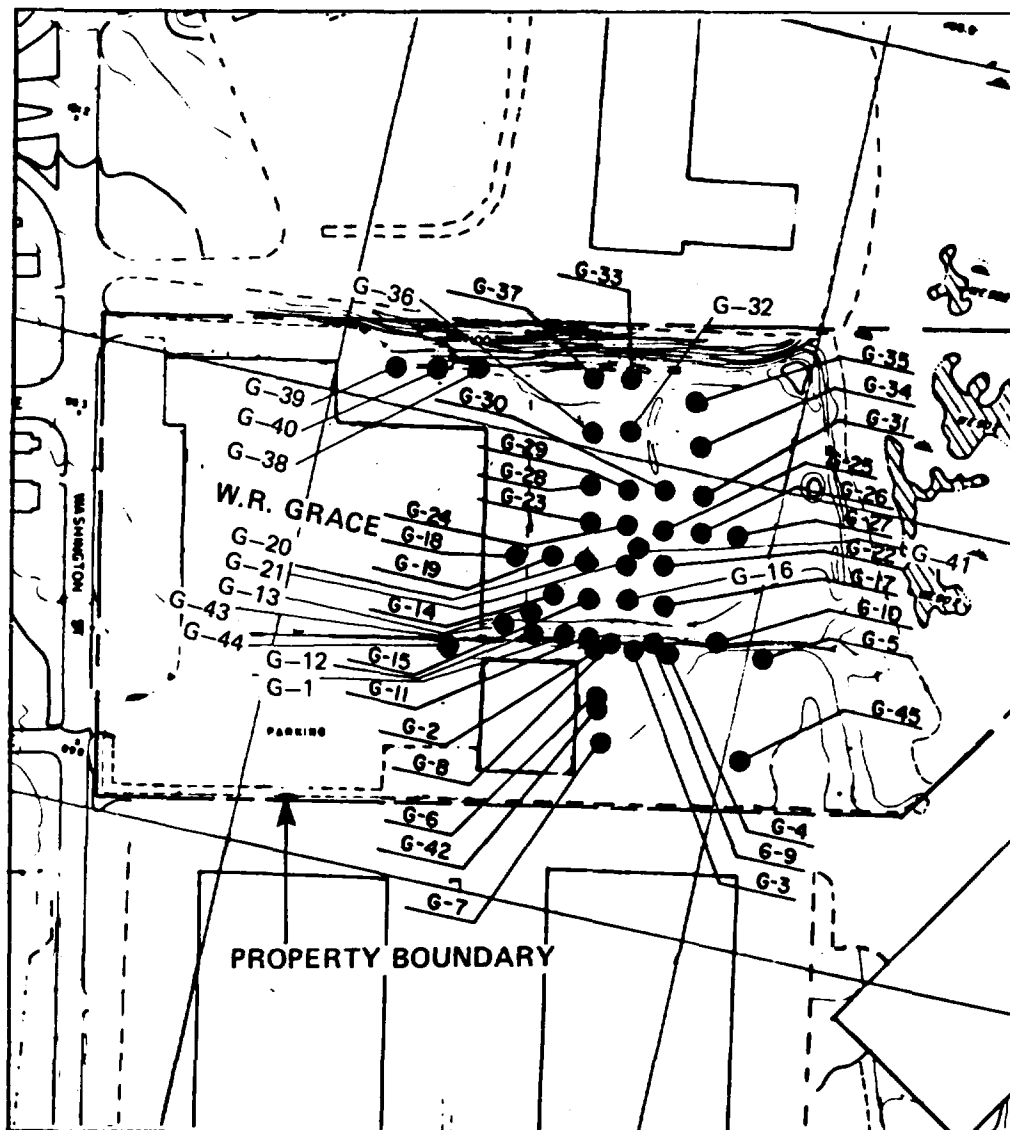
Soil Gas

A soil gas survey was also performed at the W.R. Grace & Company facility. Forty-five soil gas nodes were selected for the site as illustrated in Figure 4-4. Samples were collected at depths of three feet with a sampling grid interval of 40 feet on-center. Some locations were separated by shorter distances (i.e. 20 feet). The survey nodes were established based on an evaluation of existing data from the site. Soil gas nodes east of the facility (in front of the one story metal building and in the back area of the site) were in response to screening data obtained during the subsurface soil trenching events previously conducted at this property. Sampling points northeast and south of the main building were selected based on soil screening data collected during the previous monitoring well drilling and installation operations.

Subsurface Soil Borings and Sampling

Eight soil borings were drilled on the W.R. Grace property at the locations shown in Figure 4-5. All borings were completed using a CME-55 drill rig and the hollow stem auger method. Boring locations were determined based on site reconnaissance and the soil gas survey results. All borings were drilled to the water table (approximately six to eight feet deep). Continuous split-spoon samples were collected from all borings for classification purposes. Generally, two samples from each boring were collected for analytical laboratory testing. Analytical sample selection was based on field observations and OVA headspace screening results.

Soil samples from boring SB1 were used to characterize soil conditions in an area of high volatile organic contamination as indicated by the soil gas survey. Soil samples from borings SB2 and SB3 were used for comparison with adjacent groundwater data from monitoring wells G19 and G20, respectively. These wells have shown volatile organic contamination in the groundwater. Soil samples from borings SB4, SB5, SB6, and SB7 were used to characterize soil conditions in areas where previous trenching investigations denoted zones of subsurface soil contamination. In addition, samples from these borings were used for comparison with groundwater data from existing monitoring wells G15, G25, and G26. Soil samples from boring SB9 were used to check the potential for the eastward migration of contaminants to the drainage ditch/wetlands area. The soil samples collected at the W.R. Grace property (18 samples) were analyzed for TCL volatile organic compounds due to the significant volatile organic concentrations detected in the groundwater at this property. Three soil samples also received full TCL analysis.



100 0 100 200 300 400 500 FEET

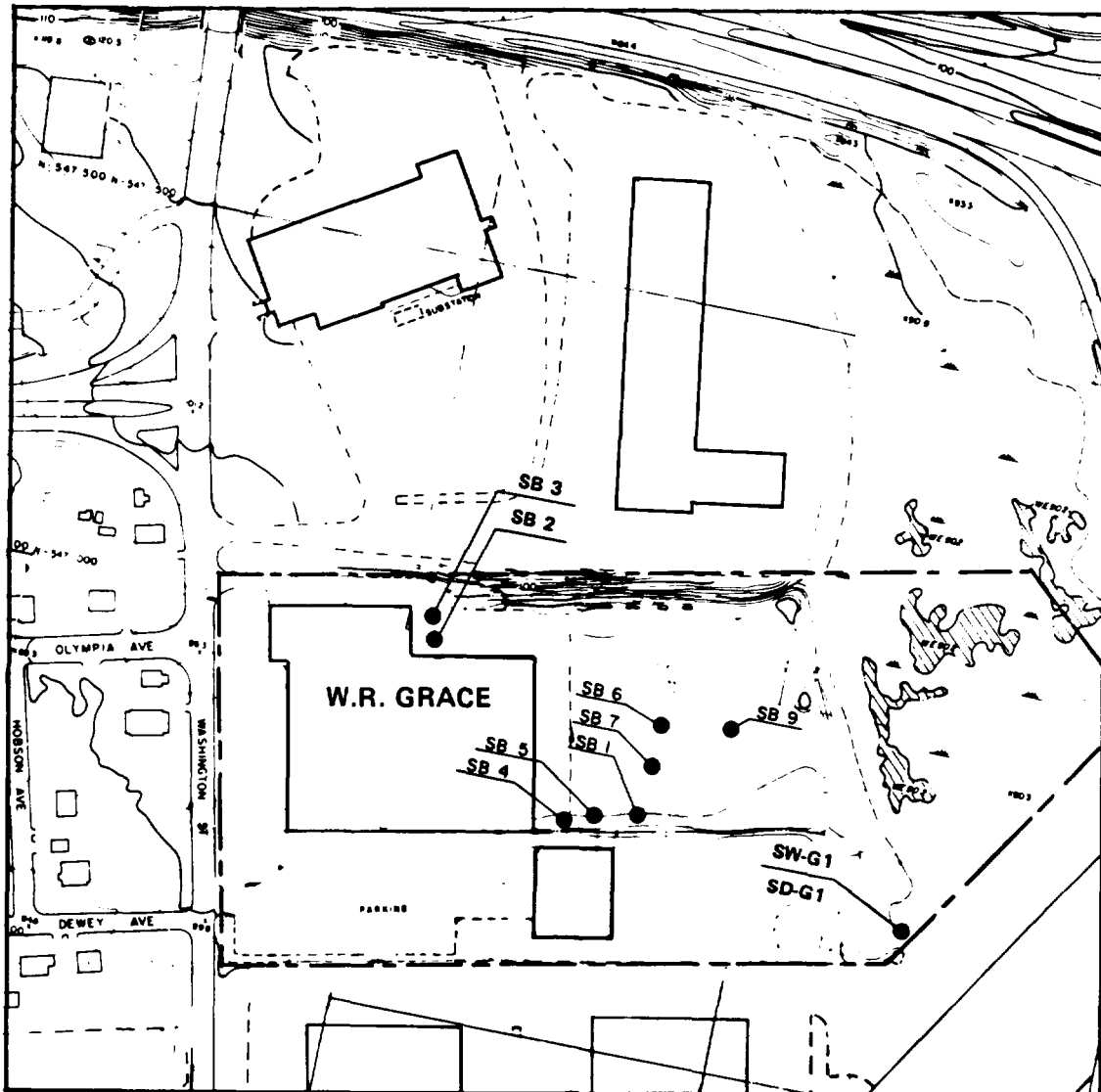
● G-36 – SOIL GAS SAMPLING LOCATION

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 4-4
W.R. GRACE PROPERTY
SOIL GAS SAMPLING LOCATIONS

EBASCO SERVICES INCORPORATED



100 0 100 200 300 FEET

SB 1 - SOIL BORING LOCATION AND NUMBER

SW-G1 - SURFACE WATER LOCATION

SD-G1 - SEDIMENT SAMPLE LOCATION

----- PROPERTY BOUNDARY

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 4-5
W.R. GRACE PROPERTY
SOIL BORING AND SURFACE WATER
SEDIMENT LOCATIONS

Although the soil gas survey indicated the presence of volatile organic contamination near the southeast corner of the one story brick building, a soil boring was not completed here due to concerns, expressed by W.R. Grace representatives, of encountering underground utilities.

Groundwater

Twenty-three groundwater samples were obtained at the W.R. Grace facility at the well locations shown previously in Figure 4-3, and Plate 1. As mentioned, groundwater data from these wells were compared with the adjacent soil boring data. In addition, the groundwater data provided an up to date evaluation of groundwater contamination at this property.

Twenty-two of the 24 groundwater samples from the W.R. Grace property were tested for TCL volatile organic compounds due to the known occurrence of volatile organic contaminants at this property. Two of the W.R. Grace samples (from Wells G3S and G15D) were tested for the full TCL parameters to provide an overall indication of groundwater quality.

4.3 Wildwood Conservation Corporation

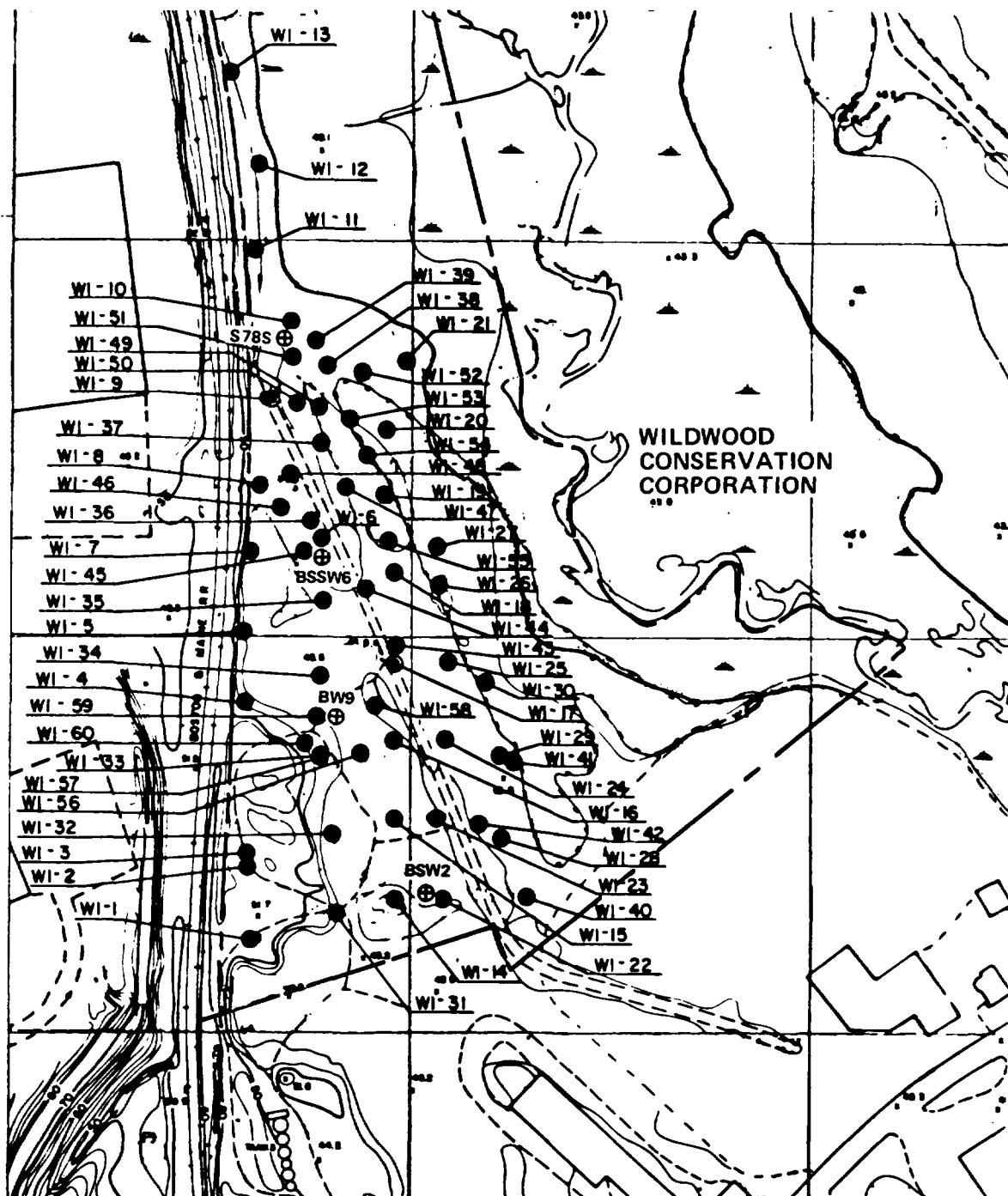
Soil Gas

The soil gas survey conducted at the Wildwood Conservation Corporation property included sampling nodes concentrated on both sides of the existing pathway through the site and continuing to the north along the railroad tracks as illustrated in Figure 4-6. These locations were chosen to investigate previous surface or subsurface disposal activities which may have impacted various areas. The soil gas survey sampling grid interval was 40 and 100 feet with sampling depth set at 3 feet. Shorter nodal spacing was used in areas where positive readings were obtained.

Surface Soils

Eight surface soil samples (SS06 to SS13) were collected from the Wildwood Conservation Corporation property using a hand auger. Two sample locations (SS06, SS07) were adjacent to the City of Woburn Sewer manhole and the MWRA Sewer manhole as shown in Figure 4-7. These surface soil samples were collected to evaluate the effect of sewer surcharging reported to have occurred at this property. Both samples were analyzed for the full TCL.

The remaining six surface soil samples were obtained from the Wildwood property for dioxin analysis. Samples were obtained using a stainless steel trowel.



100 0 100 200 300 400 500 FEET

NOTE: ● WI-1 - SOIL GAS SAMPLING LOCATION

⊕ S78S WELL LOCATION AND NUMBER

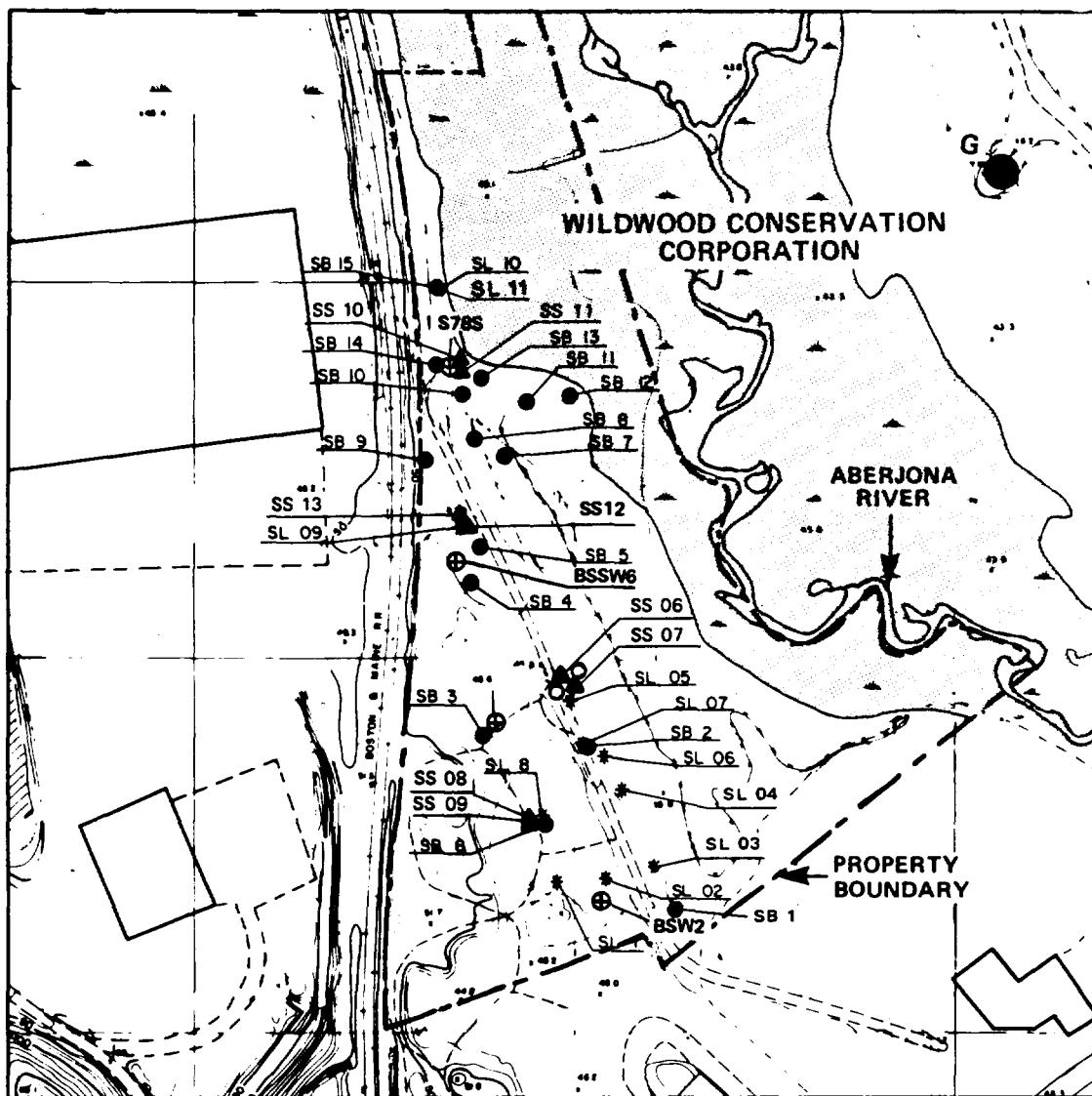
U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 4-6

WILDWOOD PROPERTY
SOIL GAS SAMPLING LOCATIONS

EBASCO SERVICES INCORPORATED



100 0 100 200 300 FEET

- SB 4 - SOIL BORING LOCATION AND NUMBER
- ⊕ S78S - WELL LOCATION AND NUMBER
- ▲ SS 06 - SURFACE SOIL LOCATION AND NUMBER
- * SL 09 - SLUDGE SAMPLE LOCATION AND NUMBER
- PROPERTY BOUNDARY
- ○ APPROXIMATE SEWER MANHOLE LOCATIONS
- - WETLANDS

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 4-7

WILDWOOD PROPERTY
SOIL AND SLUDGE SAMPLE LOCATIONS

EBASCO SERVICES INCORPORATED

Sludge

Eleven sludge samples were taken at the Wildwood Conservation Corporation in sludge areas previously delineated. Sampling and analytical testing of these areas was conducted for source characterization purposes. Ten samples and one duplicate were taken using hand held stainless steel trowels. Full TCL analyses were performed due to the present lack of information on the the sludge piles and the variety of contaminants potentially present. Sludge sample locations are shown in Figure 4-7.

Subsurface Soil Boring and Sampling

Based on the results of the soil gas survey and visual observations of contaminant conditions, soil borings (SB1 through SB15) were drilled at the Wildwood Conservation Corporation property to depths of two to six feet each (depth to groundwater) at the locations shown in Figure 4-7. The borings were completed with CME-55 and Gus Pech truck mounted rigs, and a small tripod rig. The tripod rig was used in areas which prohibited truck access. The hollow stem auger method was used at all borings completed by the truck mounted rigs. Continuous split-spoon soil sampling was conducted in each boring.

Generally, analytical laboratory samples were collected from the unsaturated zone at depths of 0-2 and 2-4 feet within each boring. Analytical sample selection was based on field observations and OVA headspace screening results.

Borings SB1, SB2, SB3, and SB5 were located in areas of former and present drum and debris disposal. The soil samples from these borings were used to characterize the potential impact of the disposal activities on subsurface soils within these areas of the Wildwood Conservation Corporation property. The remaining soil borings were located in areas of high volatile organic contamination as indicated by the soil gas survey.

Due to previous and current presence of miscellaneous drums and debris scattered and stockpiled in various areas and the previous contaminants detected at the Wildwood Conservation Corporation property, all thirty subsurface soil samples received full TCL analyses.

Groundwater

One round of groundwater samples was obtained from wells BSW7, BSW1, S78S, BOW14, BCW6, BSSW6, S95D, BOW9, BW9, BW10 and BSW2 (shown on Plate 1 and Figure 4-3). Well BSW7 served as an upgradient monitoring point. Wells BSW1 and S78S were used to monitor conditions adjacent to the northern portion of the railroad tracks. Wells BSW6, BSSW6, BOW9, BW9, BW10 and BSW2 were sampled to determine the present extent of groundwater contamination at the Wildwood Property.

All groundwater samples were analyzed for the full TCL list of compounds due to the variety of contaminants present at this property. Two wells BSSW6 and BOW14 were sampled separately for conventional parameters and treatability testing due to the high volatile organic concentrations previously detected in these wells. It should also be noted that certain wells (S78S, S95D and BSW6) were resampled in June 1988 for TCL inorganics only.

4.4 New England Plastics Company

Soil Gas

A soil gas survey was performed at the New England Plastics Property. Twenty-six sampling nodes were concentrated along the western property border as shown in Figure 4-8. These locations were selected to investigate previous surface disposal activities reported to have taken place in this area of the property. The soil gas survey sampling grid interval was forty feet on-center with a sampling depth set at 3 feet.

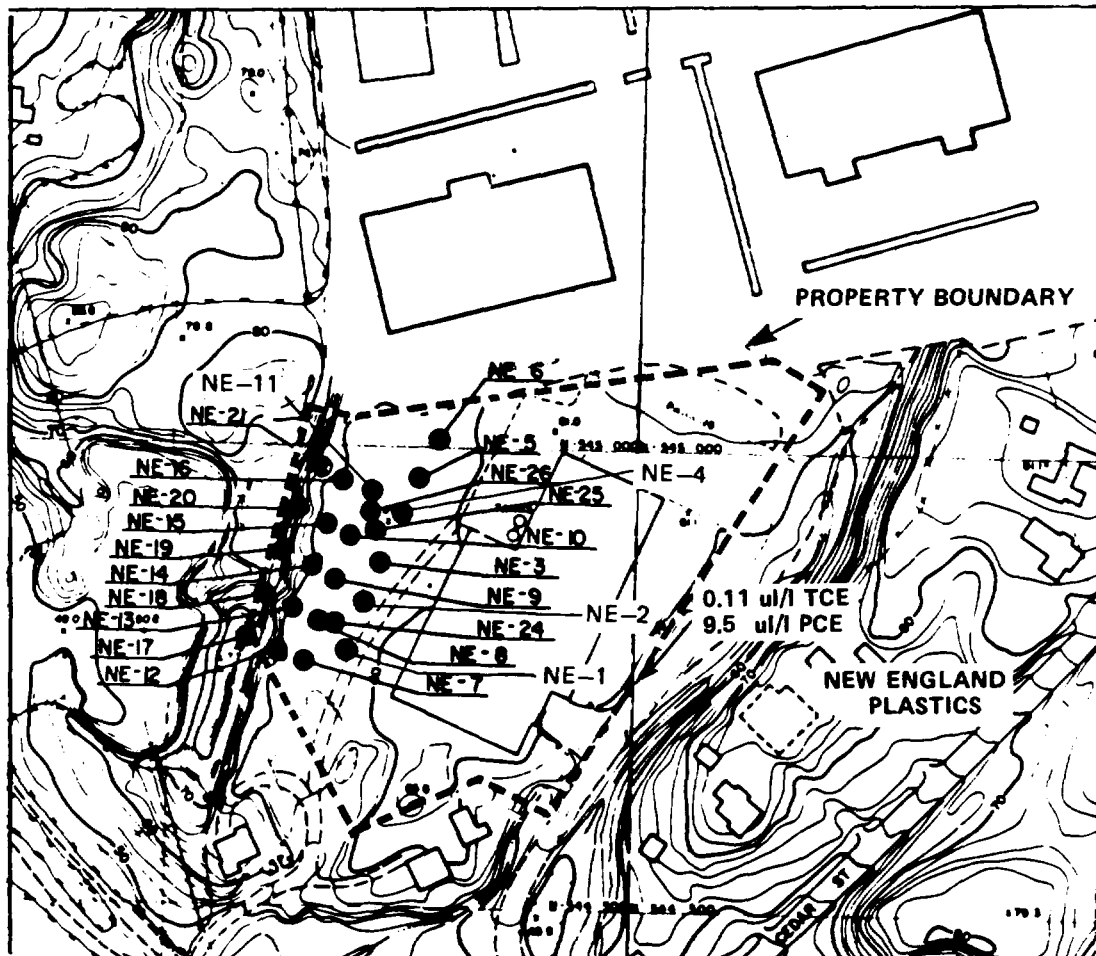
Surface Soil

Four surface soil samples and one duplicate were collected at the New England Plastics Property at locations shown in Figure 4-9. Samples were obtained from a depth of 0-6 inches with a hand held stainless steel trowel. Sample locations were based on field observations and OVA soil screening. This technique involved driving a small diameter probe into the ground to create a hole. The probe was then removed and the hole was screened with an OVA. Screening areas showing "positive" OVA readings were selected for surface soil sampling. All surface soil samples collected at this property were analyzed for the full TCL.

Subsurface Soil Borings and Sampling

Five borings were drilled at the locations shown in Figure 4-9. The borings were terminated at the water table (a depth of about 10 feet) or upon encountering refusal. Continuous split-spoon sampling was conducted in each borehole. Generally, two soil samples were collected for laboratory analysis from the unsaturated zone at each boring location. Sample selection was based on visual observations and OVA headspace screening results.

Seven samples from the five borings were analyzed for full TCL compounds to evaluate potential soil contamination from presumed disposal activities on this property.



100 0 100 200 300 400 500 FEET

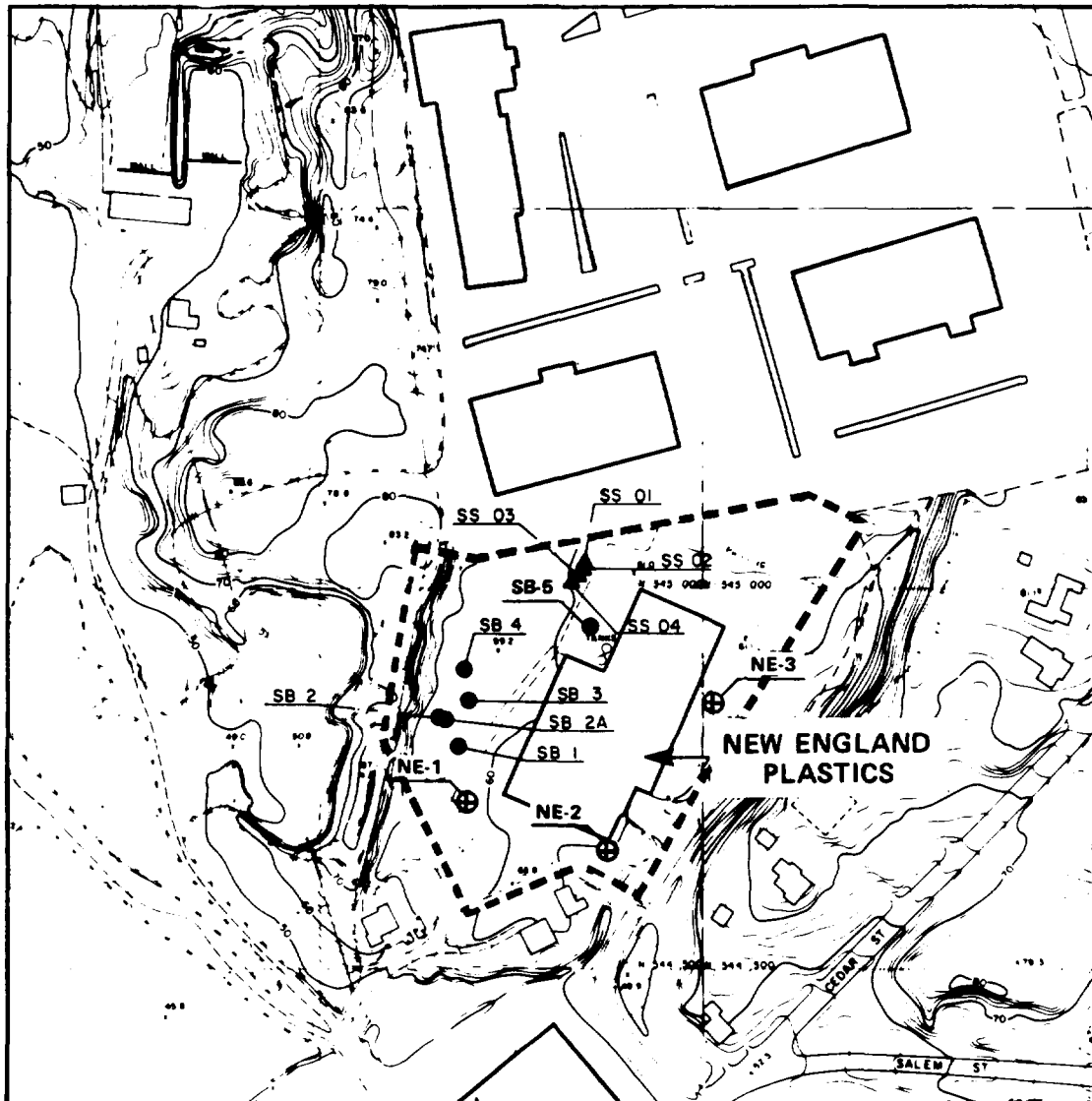
NOTE: ● NE-1 SOIL GAS SAMPLING LOCATION

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 4-8
NEW ENGLAND PLASTICS PROPERTY
SOIL GAS SAMPLING LOCATIONS

EBASCO SERVICES INCORPORATED



100 0 100 200 300 FEET

- SB 1 - SOIL BORING LOCATION AND NUMBER
- ⊕ NE-1 - WELL BORING LOCATION AND NUMBER
- ▲ SS 01 - SURFACE SOIL LOCATION AND NUMBER
- PROPERTY BOUNDARY

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 4-9
NEW ENGLAND PLASTICS
SOIL SAMPLING LOCATIONS

EBASCO SERVICES INCORPORATED

Monitoring Well Installations

To characterize other shallow soil areas and groundwater quality conditions at the New England Plastics property, three shallow (25-30 feet deep) monitoring wells were installed at the locations shown on Figure 4-9. Two soil samples were obtained from the unsaturated zone from each monitoring well borehole at depths of 4-6 and 8-10 feet. These seven soil samples including one duplicate were analyzed for the full TCL.

The three wells (NE1, NE2, and NE3) were used to establish shallow groundwater flow and quality conditions at the property for comparison with deeper bedrock groundwater quality data collected from three existing on-site wells. The on-site wells presently pump groundwater from the deep bedrock (i.e. 300 to 900 feet) for use as process water and cooling water.

Groundwater

One round of groundwater samples was obtained from the three new wells (NE1, NE2, and NE3) and the three existing onsite bedrock wells (#1, #2 and #3). The three existing bedrock well samples were collected at appropriate taps in the process water system. All groundwater samples collected at the New England Plastics property received full TCL analyses to provide information on shallow and deep groundwater contamination. Groundwater sampling locations are shown in Figure 4-3 and Plate 1.

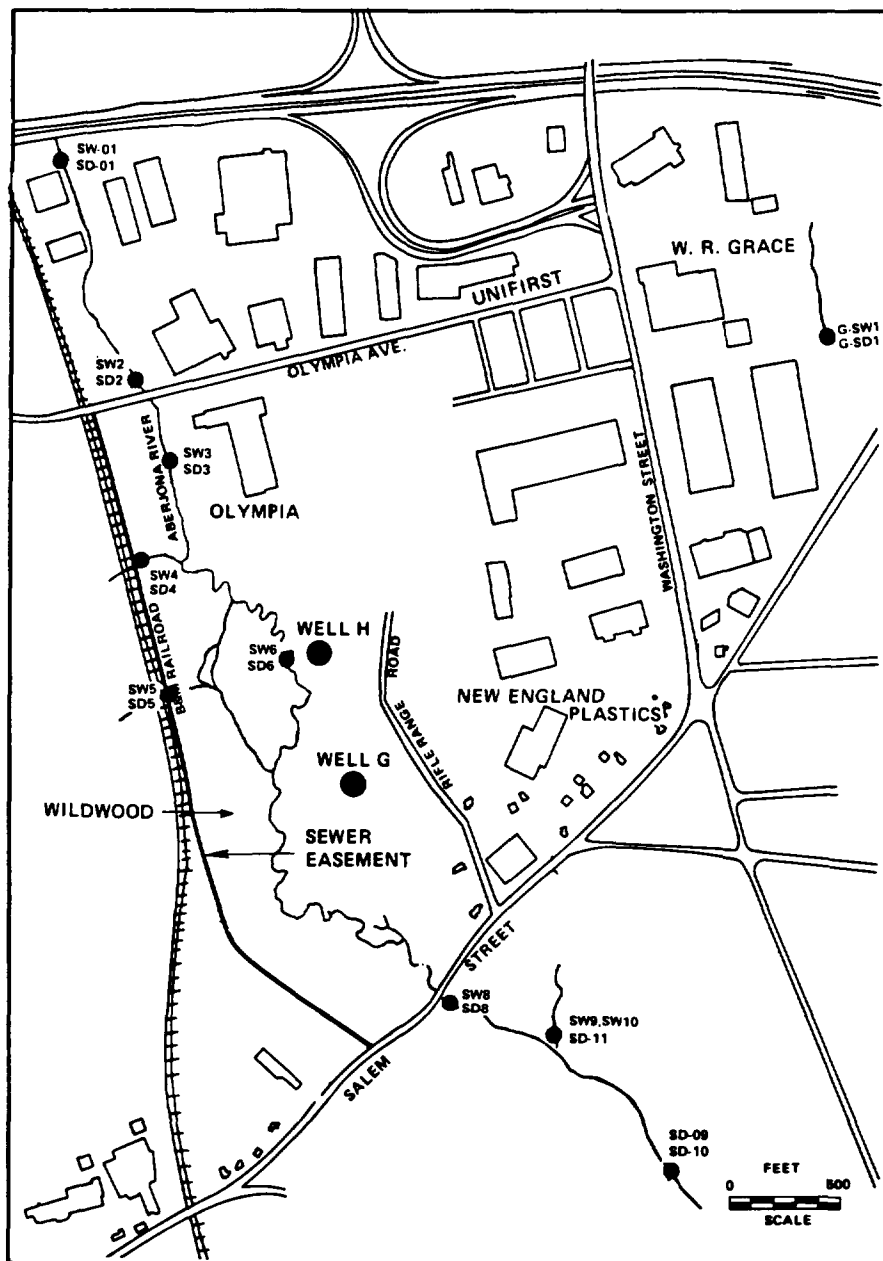
It should also be noted that certain wells (NE1 and NE2) were resampled in June 1988 for TCL inorganics only.

4.5 Central Area

Areas not bounded by specific property lines are herein denoted as the Central Area of the site.

Surface Water/Sediment

To support the Wetlands Assessment, 32 sediment samples and nine surface water samples were collected along the Aberjona River and its tributaries. One additional sediment sample and one accompanying surface water sample were also collected from the drainage ditch behind the W. R. Grace property. The collection of all surface water/sediment samples occurred during two phases of sampling: Fall-Winter 1987, and June 1988. During the first phase, fourteen sediment samples and all ten surface water samples including duplicates were collected at the locations shown in Figure 4-10. Eleven of the fourteen samples were analyzed for the full list of TCL parameters to provide information which was lacking for these media. The three remaining sediment samples (SD-09, SD-10, SD-11) were analyzed for dioxin. Surface water samples were analyzed for full TCL compounds. Surface water cross-sectional areas and velocities were measured both upstream and downstream of the site. The



- SW-01 SURFACE WATER SAMPLING LOCATION
- SD-01 SEDIMENT SAMPLING LOCATION

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 4-10
PHASE I SURFACE WATER AND SEDIMENT
SAMPLING LOCATIONS AT
THE WELLS G&H SITE

EBASCO SERVICES INCORPORATED

flow rate was determined to be approximately 11 to 12 cubic feet per second (cfs) at both the upstream and downstream locations.

The second phase of sediment sampling involved the collection of 14 additional samples. The second phase of sampling was conducted as a result of high metal concentrations observed at some locations during the first phase. Seven of the sediment samples were collected in the area north of Salem Street at an approximate spacing of 15-50 feet apart. All samples collected during the second phase were analyzed for TCL inorganics. The locations of these samples are shown in Figure 4-11.

Sewer Composites

The infiltration inflow study of the City of Woburn Sanitary Sewerage System (Whitman and Howard, 1984) indicated that there is surcharging and overflow at manholes during periods of high flow. High OVA readings were detected within the manholes during the Supplemental RI pre-sampling site visit by EBASCO personnel on 5/22/87.

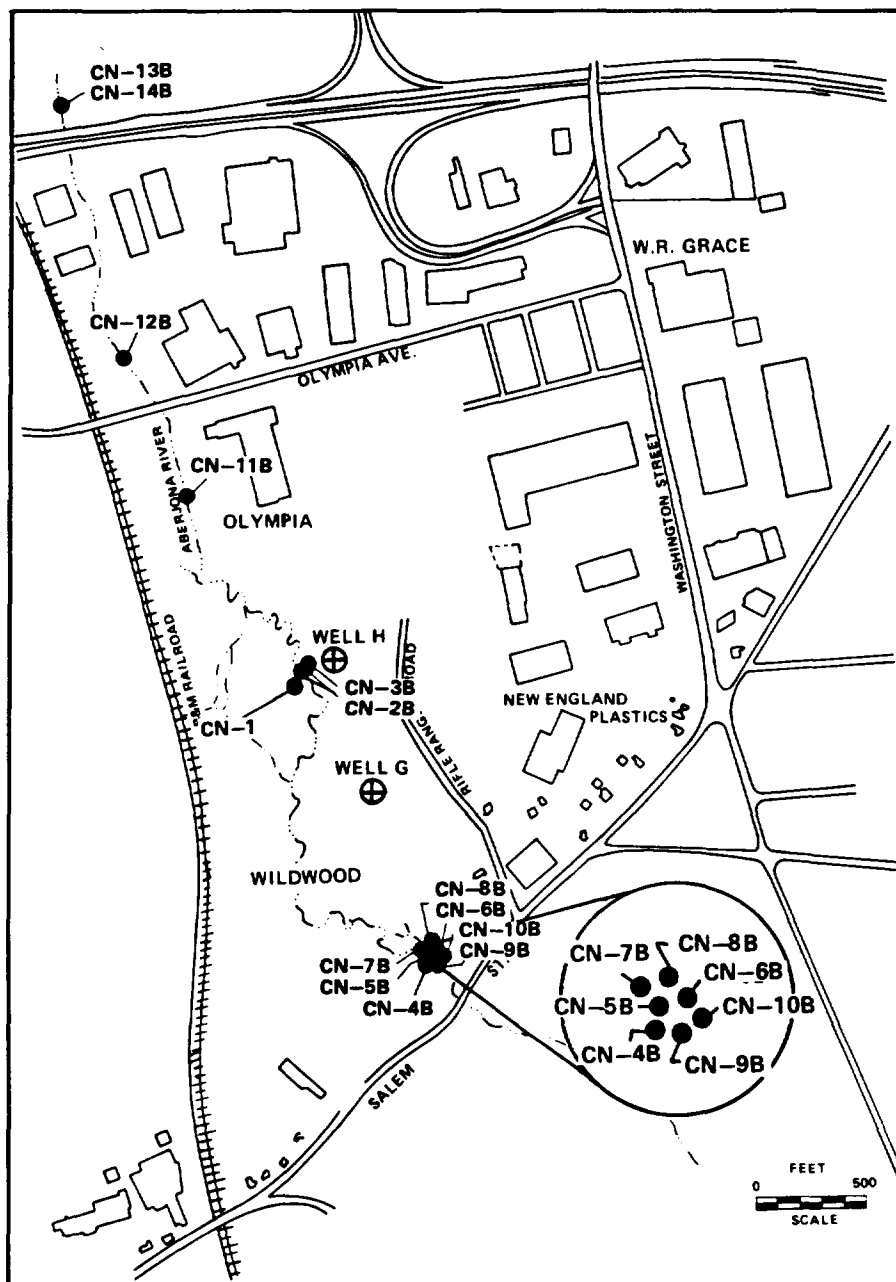
A 24-hour composite sample was collected from both the City of Woburn Sewer and the MWRA sewer along the western boundary of the Wells G & H site as shown in Figure 4-12, to evaluate the potential for local sewer lines acting as sources of contamination during overflow conditions. These two sewer composite samples were tested for the full list of TCL compounds as well as conventional parameters. An automatic sampling device (ISCO Model 2100) was used to collect a composite sample over a 24 hour period. The composite sample consisted of discrete grab samples taken at 15-minute intervals over a period of approximately 24 hours. TCL volatile organic analyses were conducted on discrete grab samples.

Surface Soils

One composite surface soil sample was obtained from a possible surface oil spillage area at the Rifle Range north of Well H as shown in Figure 4-12. The sample was used to evaluate the extent of soil contamination in this area. The sample was analyzed for full TCL.

Monitoring Well Installations

One monitoring well (AB1) was drilled in the Central Area, just south of the Wildwood Conservation Corporation property at the Aberjona Auto Facility. The location of the well is shown in Plate 1 and Figure 4-3. This well was completed at a depth of nine feet and used to monitor groundwater conditions directly downgradient of the Wildwood Conservation Corporation property and on-site at the Aberjona Auto Facility. The shallow depth of this well was the result of a clay layer encountered at a depth of eight feet. Two soil samples were obtained at this location from the unsaturated zone and analyzed for full TCL compounds.



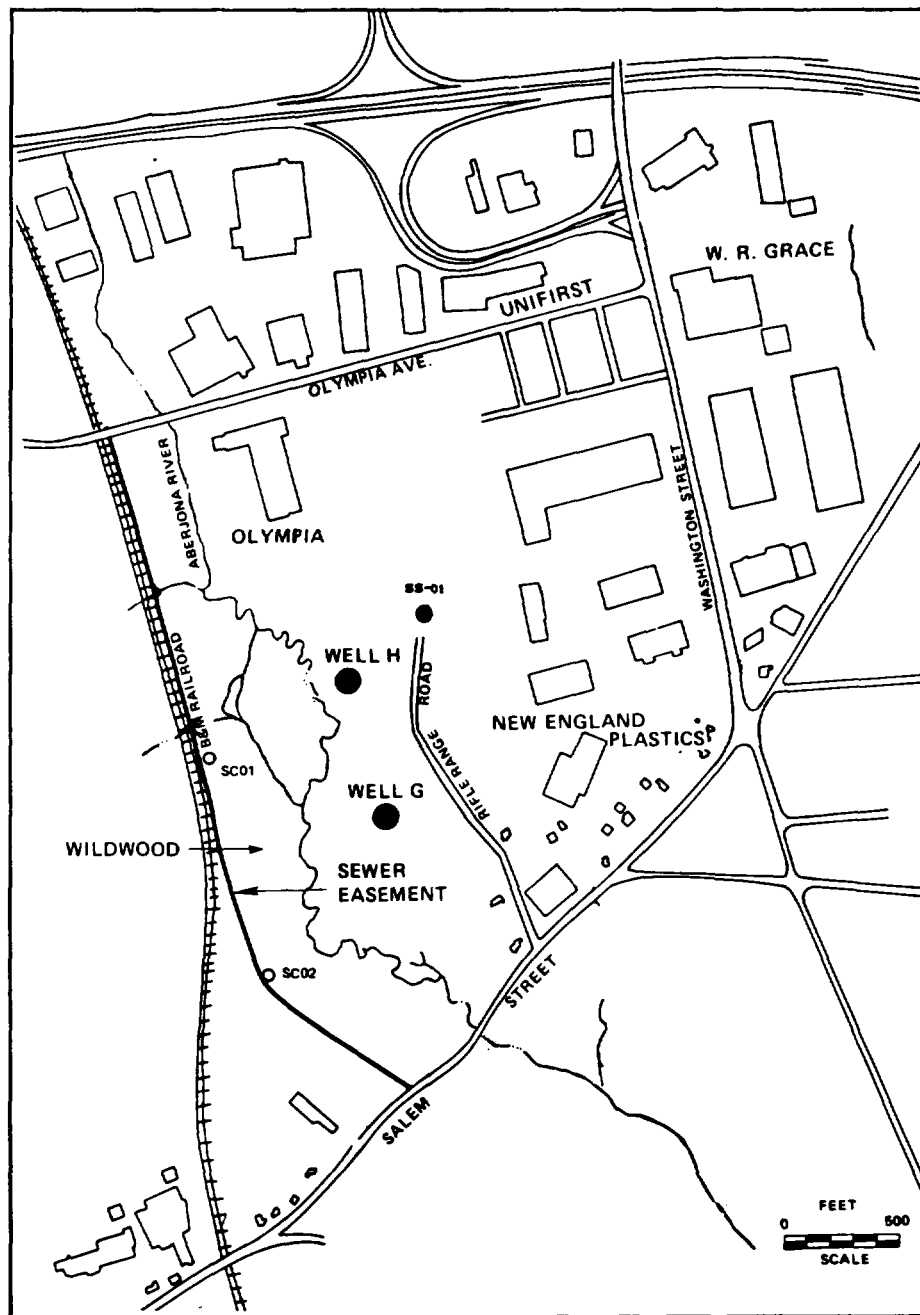
● CN-13B - SEDIMENT SAMPLING LOCATION

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 4-11
APPROXIMATE LOCATIONS OF PHASE II
SEDIMENT SAMPLES COLLECTED
DURING JUNE 1988

EBASCO SERVICES INCORPORATED



- SURFACE SOIL
- SEWER COMPOSITE
SAMPLE LOCATIONS

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 4-12

SEWER COMPOSITE AND CENTRAL AREA
SURFACE SOIL SAMPLING LOCATIONS

EBASCO SERVICES INCORPORATED

Groundwater

One round of groundwater samples was obtained from twenty-eight monitoring wells in the Central Area of the Wells G&H site as shown in Plate 1 and Figure 4-3 along with the surrounding property wells. Data from these wells were used to provide a current assessment of groundwater contamination in the Aberjona River Floodplain area (upgradient and downgradient of the site) as well as some upland areas at the Wells G&H Site. Wells located adjacent to surrounding property areas were selected to serve as "tie-in" points between the specific sampling areas and the area in which Wells G & H were located. To be consistent with the overall design of the groundwater sampling program, the Central Area wells were chosen to provide high, medium and low contaminant concentration sampling points for re-evaluation and comparison of 1985 and 1987 groundwater quality conditions. In this context the term "high" has been used to represent concentrations greater than 1,000 ug/l total volatiles, medium represents 100 - 1,000 ug/l and low is described as less than <100 ug/l. This information was used in the Feasibility Study to address overall (high and low) concentrations of groundwater contamination for collection and treatment with specific reference to changes or trends in groundwater quality over the two year time lapse between sampling programs.

The wells that were chosen to monitor upgradient and upland areas were S74S, S74D, S73S, S73D, S81S, S81D, and S22. Wells BW4, S83, AB1, S10, S11, S45, S77M, S77D, S86S and S86D were sampled to monitor downgradient conditions. Central site areas adjacent to Wells G & H were characterized by samples from wells S68S, S77D, S83D, S84S, S85M, S88S, S88M, S87S, S89S, S89M, S89D, and S94M. Collectively these wells represent areas of high, medium and low contamination based upon previous RI sampling results.

The Central Area groundwater samples were analyzed for TCL volatile organic compounds due to their proximity to Wells G & H. Two groundwater samples from the Central Area also received full TCL analysis.

In addition to the wells listed above, the following Central Area wells were sampled and analyzed for radionuclides including total radium, gross alpha and beta, and uranium: S22, S72S, S77S, S81S, and S84S.

Riley Well #1, located on the west side of the railroad tracks and downgradient of the Wildwood Property, was also sampled for the full list of TCL parameters as a check on potential migration of contaminants toward this well from adjacent areas.

4.6 Unifirst Corporation

Technical Oversight Services

Soil samples were obtained in November 1986 during on-property well boring sampling operations conducted by Unifirst's consultant (ERT) at well locations UC4 through UC7. ERT boring logs are contained in Appendix F.

Seventeen wells were sampled on the Unifirst property by ERT from 1986-1988. Fourteen of these are bedrock wells, two (UC4, UC5) are screened in both the bedrock and the overburden, and one (UC6) is screened only in the overburden. Nine of the fourteen bedrock wells (UC7, UC7A, UC9, UC10, UC11, UC12, UC13, UC14 and UC21) are equipped with Solinst Multi-port sampling devices. The multi-port devices permitted the sampling of discrete zones within the bedrock to depths of 243 feet.

Wells (UC4 - UC6) were sampled three times during 1986-1987. Bedrock wells equipped with the multi-port sampling devices were sampled by ERT three to four times during 1986-1988. Six samples of dense non-aqueous phase liquid (DNAPL) were also collected by ERT from well UC8 in January 1988.

EPA also collected groundwater samples from Unifirst property wells in 1987.

As discussed previously, EBASCO provided technical oversight of groundwater sampling conducted at two downgradient Unifirst wells by Unifirst's consultant (ERT). Unifirst was investigating the extent of free non-aqueous phase product migration in the bedrock. The two wells, UC11 and UC12 shown previously in Figure 4-3, were equipped with multiport sampling devices. These wells were sampled to determine the spatial (horizontal and vertical) distribution of contaminants. The samples received full TCL analyses.

4.7 GROUNDWATER TREATABILITY STUDY

An on-site groundwater treatability study was conducted at the site during February and March 1988 by ESE in a mobile laboratory. Tests were conducted on groundwater samples from both the Wildwood and Unifirst properties to evaluate chemical precipitation for metals removal and air stripping and carbon adsorption for removal of the volatile and semivolatile organics. Conventional parameter testing was also conducted on the well samples. The results of the treatability study are presented in Appendix D and summarized in Section 5.8.

5.0 RESULTS OF RI SAMPLING ACTIVITIES

The sampling results for this Supplemental RI, previous RI investigations, and data compiled by property owners are summarized in this section by individual property areas or source areas of contamination to Wells G&H. Data reported by property owners, for the most part, was compiled under the authority of EPA orders and with EPA over-sight. A detailed tabulation of the Supplemental RI analytical data by individual properties and sample media is included in Appendix E. Again, for convenience of discussion, and not liability purposes, areas are delineated by property ownership. Table 5-1 presents the soil gas analysis results for the individual properties for those locations at which soil gas readings were detected. Tables 5-2 and 5-3 present the maximum contaminant concentrations detected, in the soil and groundwater, respectively at each of the individual properties.

5.1 Olympia Nominee Trust

Soil Gas

The soil gas survey at the Olympia Nominee Trust property indicated the presence of only trichloroethene (TCE) at one sampling location (OL-29; shown previously in Figure 4-1) at 0.23 ul/l TCE. The low level of TCE, and the apparent absence of dichloroethene (DCE) and tetrachloroethene (PCE) suggests that this is not a zone of significant volatile organic soil contamination. It should be emphasized that although soil gas results are based on reference to calibration gases the results should be considered semi-quantitative and for relative comparison only.

Soil

Analyses from the previous Part II RI conducted by PRC Engineering (1986) indicated that contaminated soil was present at the Olympia Nominee Trust property in the area of drum and waste disposal. Sampling of drum contents and the surrounding soil revealed significant levels of PCBs (31,000 mg/kg), chlordane (51,000 ug/kg), volatile organics (primarily trichloroethene, tetrachloroethene, 1,1-dichloroethene, 1,1,1-trichloroethane) and several semivolatile organics (including 1,2,3-trichlorobenzene and 2-methyl naphthalene). In 1986, under an EPA order, these drums and soil were removed from the Olympia property. The Supplemental RI sampling conducted by Ebasco was undertaken to further investigate the property.

The results of the Supplemental RI indicate that surface and subsurface soils on the Olympia property are contaminated with low levels of (<20 ppb) volatile and semivolatile organics, and pesticides (Figure 5-1, Tables E-1, E-2 and E-3, Appendix E). Figure 5-1 shows the sampling results at selected locations to show the areal and vertical extent of contamination. PCBs were not detected in soils at this property. The soil contained

TABLE 5-1
APPROXIMATE
SOIL GAS ANALYSIS RESULTS

WILDWOOD SITE

<u>Sample (1)</u> <u>Location</u>	<u>DCE</u> <u>(ul/l)</u>	<u>TCE</u> <u>(ul/l)</u>	<u>PCE</u> <u>(ul/l)</u>
WI-6	0.08	7.6	ND
WI-9	ND	0.23	ND
WI-21	0.24	2.70	ND
WI-33	ND	0.50	ND
WI-36	ND	230.0	ND
WI-39	1.4	700.0	40.0
WI-45	0.07	39.0	4.3
WI-46	ND	2.2	ND
WI-49	ND	4.6	ND
WI-51	1.8	1.8	4.2
WI-52	ND	140.0	6.0
WI-53	ND	51.0	ND
WI-54	ND	1.6	ND
WI-57	ND	0.69	ND
WI-59	ND	3.2	ND
WI-60	ND	0.7	ND

OLYMPIA SITE

OL-29	ND	0.23	ND
-------	----	------	----

W.R. GRACE SITE

G-8	0.05	0.09	ND
G-12	ND	0.15	ND
G-16	ND	0.07	ND
G-21	ND	0.06	ND
G-25	ND	0.05	ND
G-41	ND	0.15	ND
G-44	2.7	52.0	ND

N.E. PLASTICS SITE

NE-1	ND	0.11	9.50
------	----	------	------

(1) See Figures 4-1, 4-4, 4-6 and 4-8 for soil gas sampling locations

ND - Not detected

Detection Limits were 0.05 microliters per liter (ul/l) for DCE, 0.10 ul/l for TCE and 0.40 ul/l for PCE

Data should be considered semi-quantitative and for relative comparison only.

Sample locations that revealed ND for all parameters are not listed.

TABLE 5-2

SUMMARY OF MAXIMUM CONTAMINANT CONCENTRATIONS
IN SOILS (1987 DATA) (1)

CONTAMINANT	WILDWOOD	OLYMPIA	UNIFIRST	W.R. GRACE	N.E. PLASTICS	CENTRAL AREA (WELLS G&H AREA)
Volatile Organics						
TCE	25,000	19	-	-	110,000	-
PCE	6,400	9	170	-	1,200,000	-
Methylene Chloride	800	7	25	3	9,400	3
1,1,1-TCA	4	5	12	11	13,000	-
Benzene	-	2	-	-	-	-
Toluene	56	2	6	-	-	23
Total Xylene	68	-	-	-	-	-
DCE	1,600	4	-	-	-	-
Acetone	1,400	-	170	21	120,000	130
Chloroform	900	4	-	4	3	4
Ethylbenzene	13	-	-	-	-	-
2-Butanone	900	-	-	-	-	11
2-Hexanone	51	-	-	-	-	-
Semivolatiles Organics and Pesticides/PCBs						
PAHs	43,200	6,375	NA	2	120	2,300
PCBs	130,000	-	NA	-	580	-
Chlordane	23,000	-	NA	-	-	530
Phthalates	19,000	89	NA	3	5,040,000	-
DDT	620	240	NA	24	-	-
DDE	570	88	NA	5.4	-	-
DDD	240	38	NA	-	-	-
Inorganics						
Arsenic	60.7	139	NA	18	6.8	7.7
Cadmium	27.2	3.0	NA	-	17	2.5
Chromium	3,060	924	NA	33	22	16
Iron	20,500	37,400	NA	13,800	23,100	10,100
Lead	683	424	NA	51	289	161
Manganese	262	524	NA	236	312	293
Mercury	5.5	4.2	NA	0.4	0.16	.12
Zinc	1240	486	NA	43	65	85

(1) Volatile organics and semivolatile organic concentrations in ug/kg
Inorganic concentrations in mg/kg. Estimated concentrations (J) are
also included.

- Indicates contaminant not detected
NA Not analyzed

TABLE 5-3

SUMMARY OF MAXIMUM ORGANIC CONTAMINANT CONCENTRATIONS
IN GROUNDWATER (1987 DATA) (1)

CONTAMINANT	WILDWOOD	OLYMPIA	UNIFIRST	W.R. GRACE	N.E. PLASTICS	CENTRAL AREA (WELLS G&H AREA)
<u>Volatile Organics</u>						
Acetone	-	-	110	-	-	110
Chloroform	6,000	-	5	-	1	10
2-Butanone	-	35	-	-	-	-
TCE	190,000	3,400	684	2,800	59	180
PCE	11,000	45	17,000	83	330	790
Methylene Chloride	-	-	7	63	-	-
Vinyl Chloride	73	-	-	3,600	-	-
1,1,1-TCA	2,800	2	1,700	-	26	150
Ethylbenzene	1,000	5	-	350	-	-
Toluene	-	-	400	3,600	-	8
Total Xylene	6,800	170	-	630	6	-
DCE	4,508	23	700	7,300	11	28
<u>Semivolatile Organics and Pesticides/PCBs</u>						
PAHs	3.8	146	NA	3	-	-
PCBs	-	-	NA	-	-	-
Chlordane	-	1.2	NA	-	-	-
Phthalates	4	13	NA	4	-	374
DDT	-	-	NA	-	-	-
1,2-Dichlorobenzene	10	-	NA	-	-	-

(1) All concentrations in ug/l

Estimated Concentrations are included

- Indicates contaminant not detected

NA Not analyzed

SB-1	2'-4' Depth
Total Volatiles:	ND
PAHs:	ND
PCBs:	ND
Pesticides:	ND
Phthalates:	ND

SB-2	0'-2' Depth
Total Volatiles:	ND
PAHs:	ND
PCBs:	ND
Pesticides:	ND
Phthalates:	ND

SB-3	0'-2' Depth
Total Volatiles:	ND
PAHs:	ND
PCBs:	ND
Pesticides:	ND
Phthalates:	2

SB-4	0'-2' Depth
Total Volatiles:	ND
PAHs:	ND
PCBs:	ND
Pesticides:	ND
Phthalates:	ND

SB-5	0'-2' Depth
Total Volatiles:	5J
PAHs:	ND
PCBs:	ND
Pesticides:	ND
Phthalates:	ND

SB-6	0'-2' Depth
Total Volatiles:	7
PAHs:	ND
PCBs:	ND
Pesticides:	31
Phthalates:	6

SB-7	0'-2' Depth
Total Volatiles:	8
PAHs:	13
PCBs:	ND
Pesticides:	ND
Phthalates:	5

SB-8	0'-2' Depth
Total Volatiles:	ND
PAHs:	15.2
PCBs:	ND
Pesticides:	ND
Phthalates:	11

SB-9	2'-4' Depth
Total Volatiles:	2
PAHs:	.8
PCBs:	ND
Pesticides:	ND
Phthalates:	6

SB-10	0'-2' Depth
Total Volatiles:	ND
PAHs:	13
PCBs:	ND
Pesticides:	ND
Phthalates:	3

OL-1	2'-4' Depth
Total Volatiles:	ND
PAHs:	ND
PCBs:	ND
Pesticides:	22
Phthalates:	65

OL-4	0'-2' Depth
Total Volatiles:	12
PAHs:	ND
PCBs:	ND
Pesticides:	ND
Phthalates:	ND

OL-5	0'-2' Depth
Total Volatiles:	ND
PAHs:	ND
PCBs:	ND
Pesticides:	ND
Phthalates:	ND

OL-2	0'-2' Depth
Total Volatiles:	ND
PAHs:	ND
PCBs:	ND
Pesticides:	ND
Phthalates:	ND

OL-3	0'-2' Depth
Total Volatiles:	10
PAHs:	980
PCBs:	ND
Pesticides:	46
Phthalates:	89J

SS-04	0'-1' Depth
Total Volatiles:	ND
PAHs:	6375
PCBs:	ND
Pesticides:	366
Phthalates:	ND

- SB1 - SOIL BORING LOCATION AND NUMBER
 ⊕ OL-1 - WELL BORING LOCATION AND NUMBER
 ▲ SS08 - SURFACE SOIL LOCATION AND NUMBER
 * SWSD3 - SURFACE WATER SEDIMENT LOCATION AND NUMBER
 □ WETLANDS
- ND - NOT DETECTED
 J - ESTIMATED CONCENTRATION

Displayed sample concentrations have been selected to represent area wide distribution of contamination.

100 0 100 200 300 400 500 FEET

SCALE IN FEET

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 5-1

REPRESENTATIVE OLYMPIA PROPERTY
SOIL CONCENTRATIONS (ug/kg)

EBASCO SERVICES INCORPORATED

phthalates at a maximum concentration of 89 ug/kg, DDT at up to 240 ug/kg, PAHs at up to 6375 ug/kg and volatile organics up to 19 ug/kg TCE (Table 5-2). The depth of soil contamination is generally 0 to 6 feet as determined by the soil samples collected to the water table.

Three surface soil samples, SS-14, SS-15, SS-16, as shown in Figure 5-1 from the Olympia property were also analyzed for dioxin. Analyses indicated that dioxin, in the form of the heptachlorodibenzo dioxin (HpCDD) and octachlorodibenzo (OCDD) congeners were present at location SS-15 at concentrations of 1.17 ng/g and 16.54 ng/g, respectively (Table E-4, Appendix E). In addition octachloro- dibenzofuran (OCDF), was detected at SS-16 (6.7 ng/g).

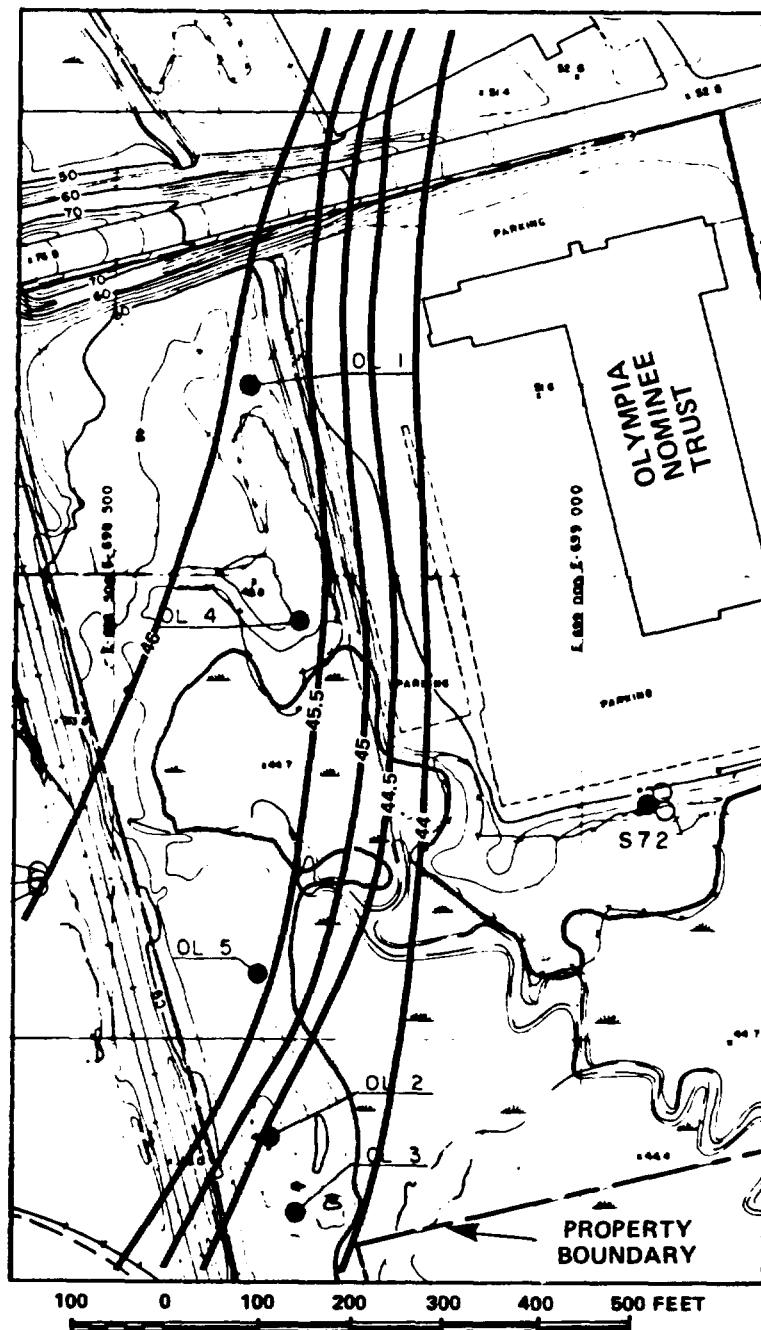
Overall inorganic concentrations in surface and subsurface soils at the Olympia property are generally low (Tables E-1, E-2 and E-3). The concentrations of most heavy metal constituents appear to be within typical ranges for U.S. soils as discussed by Conner and Shacklette (1975). However, the maximum observed concentration of arsenic (139 mg/kg), appears to be slightly elevated with respect to soil ranges which are typically less than 65 mg/kg.



Groundwater

Five on-property and two off-property wells (Figure 4-3 and Plate 1) were sampled to determine the extent and type of overburden groundwater contamination at the Olympia Nominee Trust property. Table 5-3 and Table E-5 in Appendix E present the results which indicate that portions of the property have detectable concentrations of TCL volatile and semivolatile organics, and TCL inorganics in the overburden aquifer.

A groundwater elevation contour map for the Olympia property, constructed from data obtained at the time of groundwater sampling is presented in Figure 5-2. Groundwater elevation and depth to water data are listed in Table A-4, Appendix A.

Volatile organic contamination consisted primarily of the volatile organics TCE, PCE, benzene and xylene. Elevated levels of these compounds were detected at OL2 (TCE = 3,400 ug/l, PCE = 33 ug/l, total xylene = 140 ug/l), OL3 (TCE = 180 ug/l, PCE = 45 ug/l) and OL4 (benzene = 16 ug/l and total xylenes = 10 ug/l). Only trace Volatile Halogenated Organics (VHOs) (less than 6 ug/l total VHOs) were detected at well OL5 or at S72S and the upgradient well S76M indicating that much of the groundwater volatile organic contamination is present only in the area of wells OL2 and OL3. Potential sources of the benzene and xylene contamination are currently being investigated by the Massachusetts Department of Environmental Quality (DEQE). Xylene and ethylbenzene were also detected at OL1 which is upgradient of this property.



 GROUNDWATER ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL
 OL5 WELL LOCATION AND NUMBER

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 5-2
 OLYMPIA PROPERTY
 GROUNDWATER ELEVATIONS - 1987

EBASCO SERVICES INCORPORATED

Semivolatile organic groundwater contamination at or near the Olympia Nominee Trust property was detected at three locations. At well OL4, naphthalene (120 ug/l), acenaphthylene (7 ug/l), acenaphthene (13 ug/l), and phenanthrene (6 ug/l) were detected. Bis(2-ethylhexyl) phthalate was detected at wells S72S and S76M at concentrations of 8 and 14 ug/l, respectively.

One pesticide (chlordane) was detected in the groundwater sample from OL3 at a concentration of 1.2 ug/l.

Results of analyses of total (unfiltered) and dissolved (0.45 micron filter) TCL inorganics are included in Appendix E (Table E-6). Dissolved concentrations of metals (arsenic, barium, cadmium etc.) listed in The Safe Drinking Water Act (50 Federal Register 46902, 1985) were below their respective maximum contaminant levels (MCLs) in samples from wells OL1, OL2 and OL3. However, maximum dissolved concentrations of iron (6040 ug/l) and manganese (4220 ug/l) at OL1 were elevated. Maximum total (unfiltered) iron (1030 mg/l) and manganese (16.7 mg/l) levels were also elevated. The relatively large differences in total and dissolved iron and manganese results may reflect the presence of high concentrations of sediment adsorbed iron and manganese.

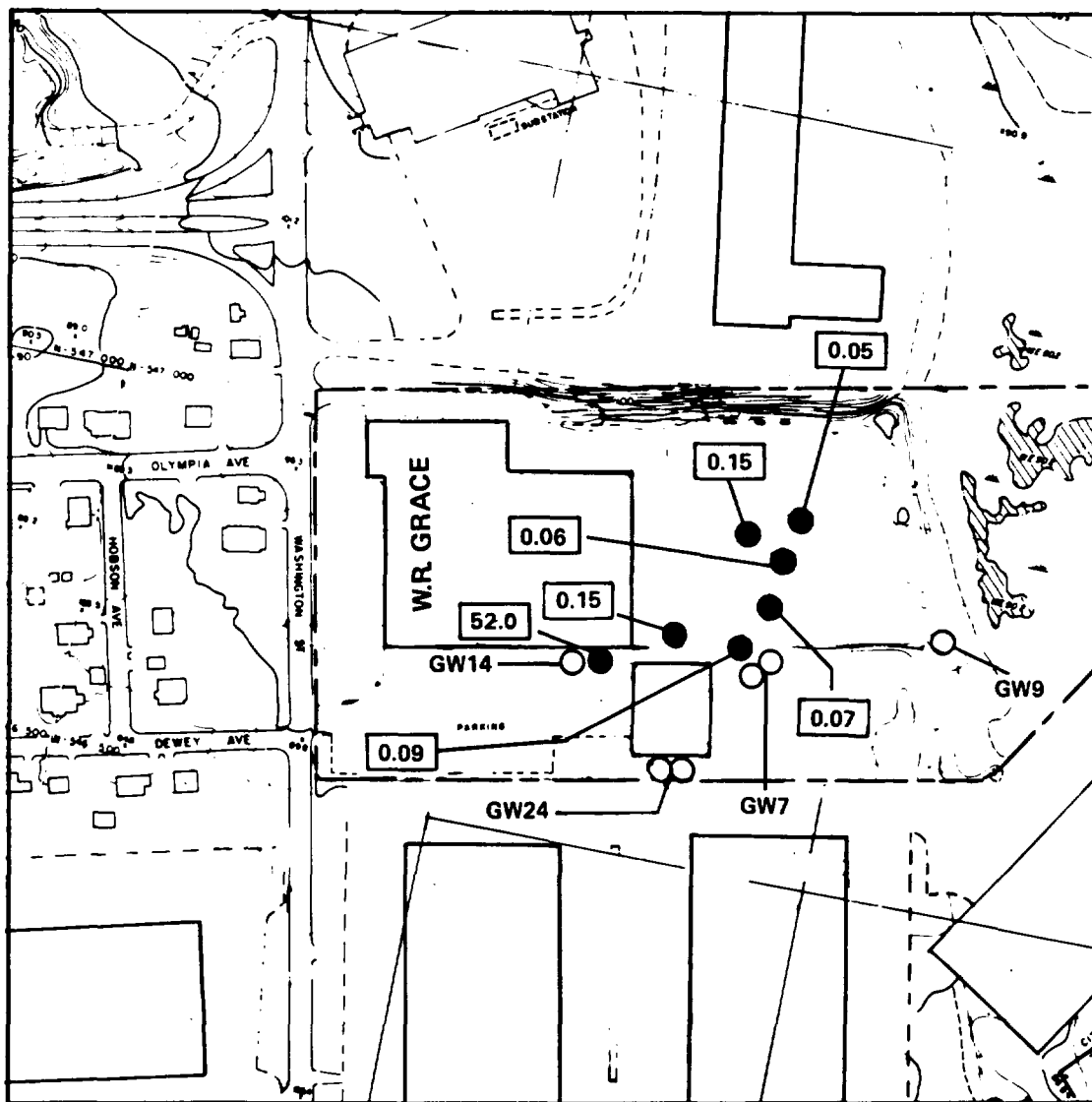
5.2 W.R. Grace and Company

Soil Gas

The soil gas survey conducted at the W.R. Grace property indicated detectable concentrations of TCE and DCE. PCE was not detected. The concentrations of TCE and DCE may be indicative of soil or groundwater contamination. Only one sample (G-44) had a particularly elevated TCE concentration (52 ul/l). This sample was obtained from an area covered by asphalt near the southeast corner of the one story brick building as shown in Figure 5-3. Since underground utilities information in the vicinity of G-44 was not available, additional samples in this area were not collected.

Soil

Contaminated soil and drums, in and around the waste disposal area at the W. R. Grace Property, were excavated and removed in 1985. Soil samples collected during this Supplemental RI showed detectable levels of volatile organics, phthalates, DDT, DDD, and DDE primarily at the rear of the facility (Figure 5-4, Table 5-2 and Table E-7). Other than methylene chloride (less than 5 ug/kg) and acetone (up to 21 ug/kg) which are possible laboratory contaminants the only volatile halogenated organics (VHOs) which were detected in soil samples at this property were 1,1,1-trichloroethane (maximum concentration 11 ug/kg) and chloroform (maximum concentration 4 ug/kg).



100 0 100 200 300 FEET

--- PROPERTY BOUNDARY

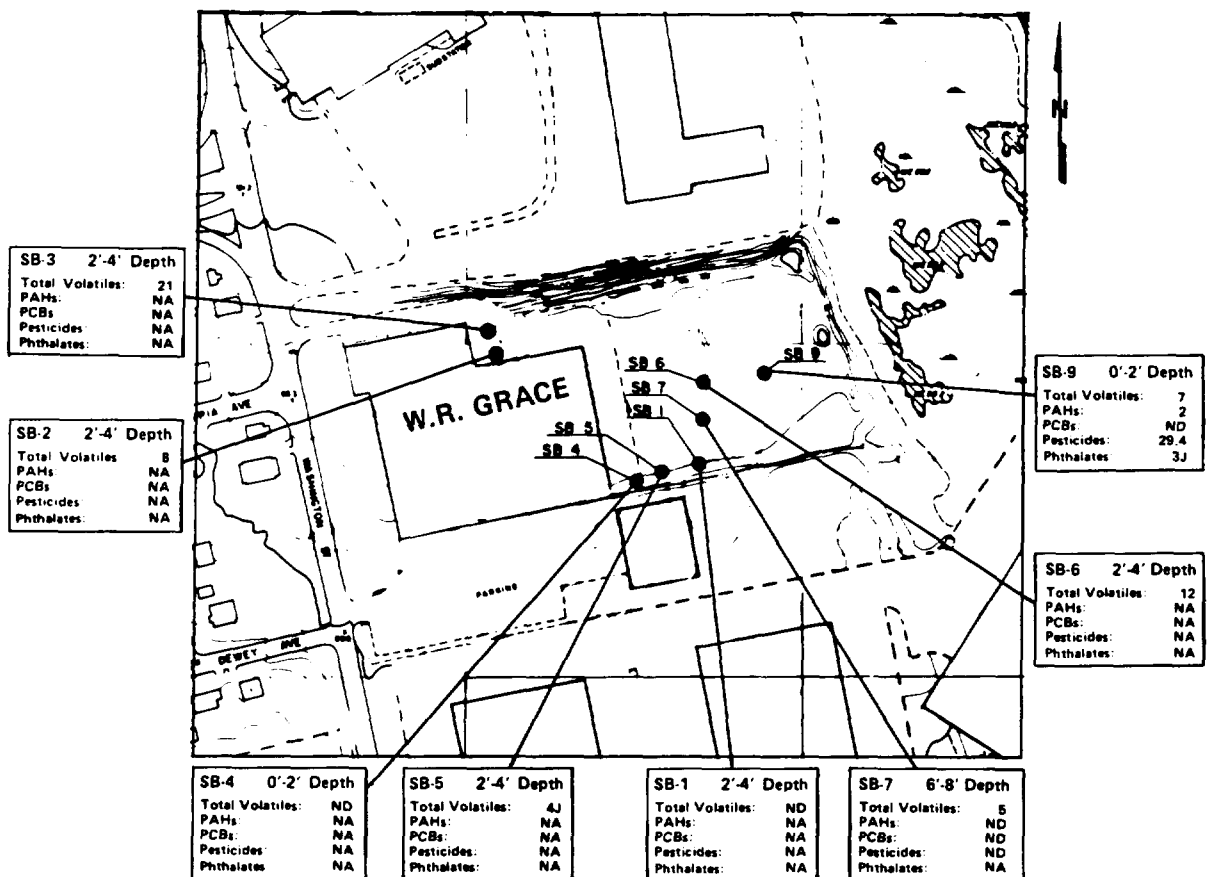
U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 5-3

LOCATIONS OF ELEVATED TCE SOIL GAS
LEVELS (u/l) AT W.R. GRACE

EBASCO SERVICES INCORPORATED



100 0 100 200 300 400 500 FEET

SCALE IN FEET

- SB1 - SOIL BORING LOCATION AND NUMBER
 ⊕ GW14D- WELL LOCATION AND NUMBER
 --- PROPERTY BOUNDARY
 ND - NOT DETECTED
 J - ESTIMATED CONCENTRATION
 Displayed sample concentrations have been selected to represent area wide distribution of contamination.

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 5-4

W.R. GRACE PROPERTY
SOIL CONCENTRATIONS (ug/kg)

EBASCO SERVICES INCORPORATED

The only semivolatiles which were detected were di-n-butyl phthalate (maximum concentration 3 ug/kg) and benzo-b-fluoranthene (maximum concentration 2 ug/kg) both reported at boring SB-9. Also detected at boring SB-9 were 4-4' DDT (24 ug/kg) and 4,4' DDE (5.4 ug/kg).

Inorganics were analyzed in three soil samples. Heavy metal concentrations are generally consistent with typical ranges for U.S. soils as discussed by Conner and Shacklette (1975). In addition, no cyanides were detected in any of the three samples.

Groundwater

Twenty-three wells were sampled to characterize groundwater contamination at the W.R. Grace property. Fourteen of the wells sampled were screened in the overburden, nine wells were screened in the bedrock. Groundwater data from the W.R. Grace property are presented in Table 5-3 and Table E-8, Appendix E.

Volatile organic contamination in the groundwater in the overburden at the W.R. Grace property consists predominantly of the VHOs trichloroethene (TCE), vinyl chloride, and 1,2-dichloroethene (DCE). Although these compounds are present in the overburden over much of the property, three areas (see Figure 4-3 and Plate 1) are characterized by VHO levels greater than 1000 ug/l: the northern portion of the property in the vicinity of G20S, the southeast corner of the large building near G15S and G14S, and the southwest portion of the property near G3S. The maximum concentration exceeded 1000 ug/l for TCE (2800 ug/l) at well G20S, DCE (7300 ug/l) at G15D, while the maximum concentrations of vinyl chloride (3600 ug/l) and toluene (3600J ug/l) occurred at G15D.

Volatile organic contamination also exists in the bedrock at the W.R. Grace property. The areal extent of bedrock contamination apparently is not as extensive as in the overburden, however, the concentrations are similar to those observed in the overburden. The areas contaminated by total volatile organic concentrations greater than 1000 ug/l are near G3DB, G15D, and G16D.

At the G-15 well location two of the principal organics present in the G-15S shallow well (toluene, 2100 ug/l; vinyl chloride, 2900 ug/l) were also present in generally similar concentrations in the G-15D deep well location (toluene, 3600 ug/l; vinyl chloride 3600 ug/l). However, at the G-3 well location the principal VHOs detected in the G3S shallow well were TCE, 1300 ug/l and 1,2-DCE, 1400 ug/l while vinyl chloride (250 ug/l) was the principal contaminant in the G-3D deep well.

The only semivolatiles which were detected in the three wells in which they were analyzed (G25S, G3S and G15D) were bis(2-ethylhexyl)phthalate (maximum concentration 4 ug/l) and naphthalene (maximum concentration 3 ug/l).

Only two wells were sampled for total (unfiltered) metals, G3S and G15D. Results from G3S (screened in the overburden) showed levels greater than 1000 ug/l for several metals including aluminum, calcium, iron, and magnesium. Similar levels of calcium and magnesium were present in G15D (screened in bedrock). Concentrations of metals listed in the Safe Drinking Water Act (50 Federal Register 46902, 1985) were near or below their respective maximum contaminant limits.

5.3 Wildwood Conservation Corporation

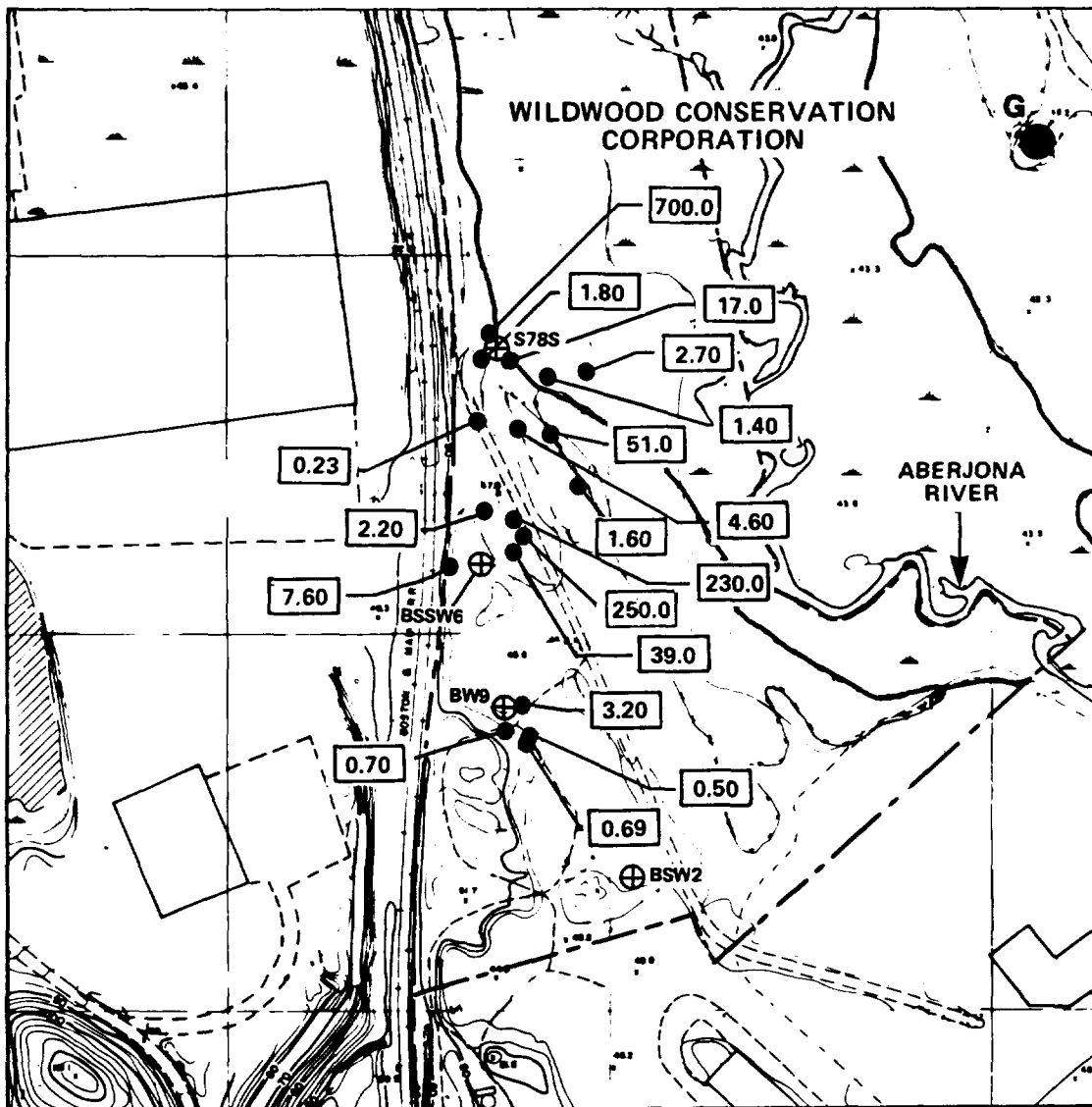
Soil Gas

The soil gas survey conducted at the Wildwood Conservation Corporation property indicated the presence of DCE, TCE, and PCE. Soil gas survey results are tabulated in Table 5-1. Three separate zones of contamination were identified as shown in Figure 5-5. The northernmost zone of contamination was in the vicinity of sample WI-39 (see Figure 4-6). In this zone TCE (at 700 ul/l) was the primary compound detected with PCE (40 ul/l) and DCE (1.4 ul/l) present at lower concentrations. An unknown compound, possibly trichloroethane (TCA), was also detected in this area. The second zone of contamination was in the vicinity of WI-45. At this locality TCE again was the primary compound detected (at 39 ul/l) with PCE (4.3 ul/l) and DCE (0.07 ul/l) also present. The unknown resembling TCA was not detected in this zone. A third zone of contamination was found in the central to southern portion of the property, in the vicinity of sample WI-59. In this zone only TCE was detected (at 3.2 ul/l). The maximum concentrations in zones one and two were 10 to 100 times greater than the maximum concentrations in zone three.

Soil

Soil sampling from the previous Part I and Part II RIs indicated that soil at the Wildwood Conservation Corporation property was predominantly contaminated by volatile organics, PCBs and pesticides. Concentrations of TCE (up to 11,000 ug/kg), PCE (up to 130,000 ug/kg) and trans-1,2-DCE (up to 13,600 ug/kg) were present at subsurface depths of 2 to 4 ft as evidenced from the Part II RI data. Concentrations of chlordane (up to 9,300 ug/kg) were also identified in the soil. These contaminants were present primarily in the central and north central portions of the property and in the sludge piles to the south near the entrance of the property.

Soil sampling conducted during this Supplemental RI at the Wildwood Conservation Corporation property showed TCE, PCE, 1,1,1 TCA, xylene, phthalates, total PAHs, PCBs, and chlordane present (Figure 5-6, Table 5-2 Table E-9, and E-10, Appendix E). The principal volatile organics which were detected were the VHOs TCE (up to 25,000 ug/kg), and PCE (up to 6,400 ug/kg). Lower concentrations of 1,2-DCE (up to 1600 ug/kg) and other VHOs were detected. Monocyclic aromatics such as toluene and



BSW2

⊕ WELL LOCATION AND NUMBER

100 0 100 200 300 FEET

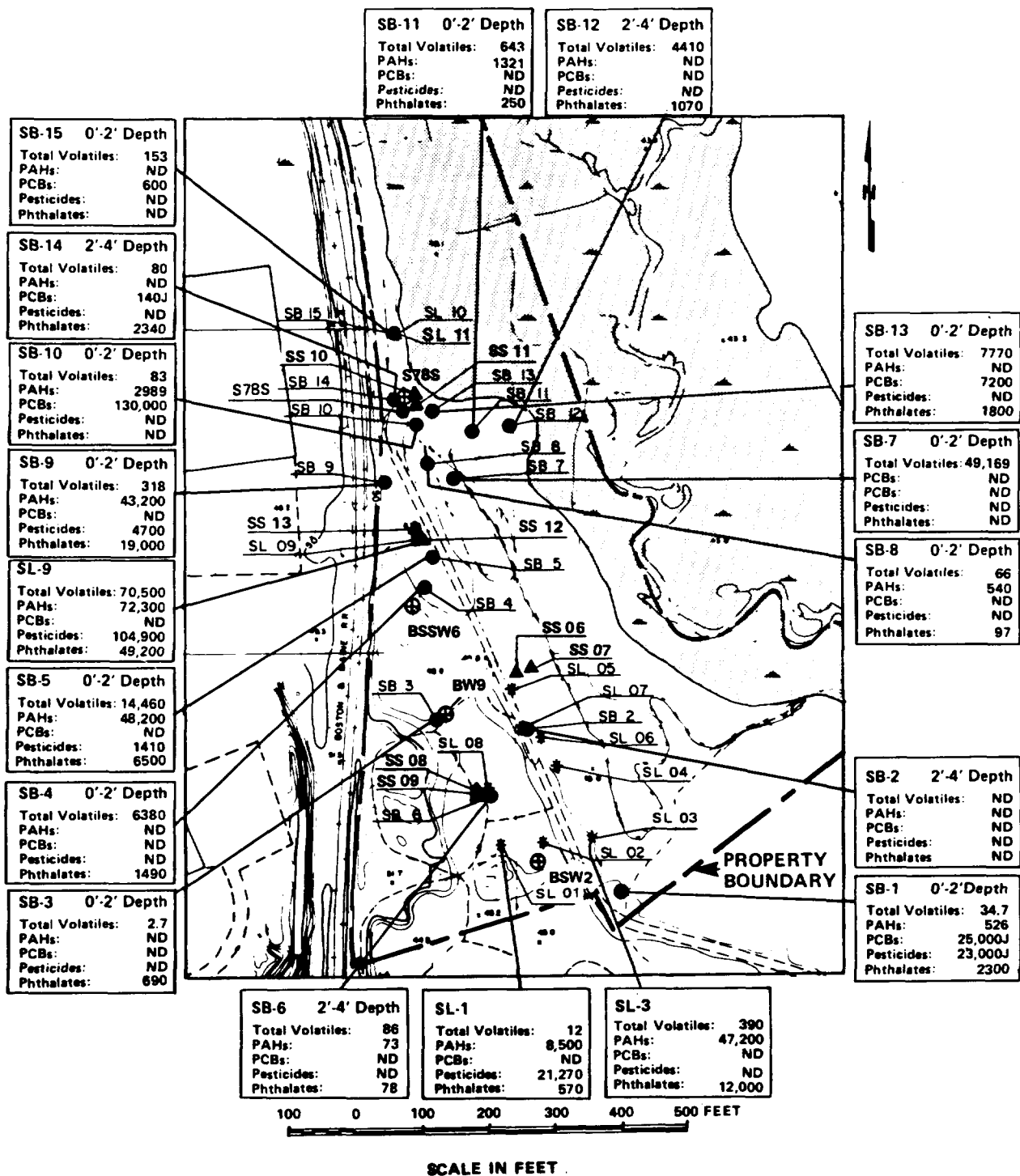
— — — — — PROPERTY BOUNDARY

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 5-5
LOCATIONS OF ELEVATED TCE
SOIL GAS LEVELS (ul/l) AT WILDWOOD
CONSERVATION CORPORATION

EBASCO SERVICES INCORPORATED



- SB 4 - SOIL BORING LOCATION AND NUMBER
- ⊕ S78S - WELL LOCATION AND NUMBER
- ▲ SS 06 - SURFACE SOIL LOCATION AND NUMBER
- * SL 01 - SLUDGE SAMPLE LOCATION AND NUMBER

□ - WETLANDS

ND - NOT DETECTED

J - ESTIMATED CONCENTRATION

Displayed sample concentrations have been selected to represent area wide distribution of contamination.

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 5-6
REPRESENTATIVE WILDWOOD
SOIL CONCENTRATIONS (ug/kg)

EBASCO SERVICES INCORPORATED

xylene were detected in only a few samples at concentrations below 100 ug/kg. Maximum TCE and PCE concentrations were detected in soil boring SB-13 at 2 to 4 foot depths.

Several PAHs including acenaphthylene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(a)pyrene and benzo(a)fluoranthene were detected in certain soil samples at levels greater than 1,000 ug/kg. Overall, maximum soil concentrations of TCE, PCE, and chlordane were higher than were reported in previous RI data. In addition, PAHs, PCBs, and DDT, which were not identified in the previous RI, were detected in the samples of this study. Generally, soil contamination at the Wildwood property was found at varying depths from the surface down to the water table at 4 feet.

Seven surface soil samples (SS-08 to SS-13), as shown in Figure 5-6 from the Wildwood Conservation Corporation property were also analyzed for dioxin. Results (Table E-11, Appendix E) indicate that dioxin, in the heptachloro (HpCDD) and octachloro (OCDD) forms, was present at 38.2 ng/g and 3.7 ng/g, respectively, at SS-13. Tetrachlorodibenzo-p-dioxin (TCDD) isomers were not detected.

Overall concentrations of inorganics in Wildwood property soils appear to be within typical ranges for soils (Conner and Shacklette, 1975). However, the maximum concentrations of certain metals including chromium (3060 mg/kg) at SB10 at 0 to 2 feet, lead (683 mg/kg) and zinc (1240 mg/kg) at SB1 are somewhat elevated in comparison to other on-property samples and generally observed ranges.

Waste Material and Sludge

Numerous piles of waste and debris were identified at the Wildwood Conservation Corporation property during previous site investigations. These debris piles consist of sludge material, wooden debris, trash, plastics, scrap metals, glass, concrete blocks, discolored soil, rusted drums, pesticide containers, sand, asphalt, auto parts, etc. Most of these piles would be classified as non-hazardous waste if removed for disposal to an off-site landfill. Table E-12, Appendix E presents the results of analyses of 11 sludge samples collected from some of the individual waste debris areas at the Wildwood property. As shown, contaminants such as volatile organics, PAHs, phthalates, and pesticides were detected at several locations. Among the volatile organics detected were PCE (up to 86,000 ug/kg), trichloroethene (up to 15,000 ug/kg) at SL08 and xylene (up to 61,000 ug/kg total xylene) at SL-09.

Semi-volatile organics including PAHs, phthalates, and substituted phenols were detected in the sludge samples as were certain pesticides. Pentachlorophenol was detected at up to 110,000 ug/kg in sample SL-08. In the same sample bis(2-ethyl hexyl)-phthalate was detected at 150,00 ug/kg and 4,4'-DDT at 320,000

ug/kg. As indicated, concentrations of the PAH 2-methylnaphthalene reached 600,000 ug/kg at location SL-10.

Sludge inorganic concentrations vary widely. In particular, maximum detected concentrations of lead (10,000 mg/kg) at SL-05, cadmium (18 mg/kg) at SL-03 and chromium (802 mg/kg) at SL-09 are all over an order of magnitude greater than minimum observed values. These concentrations suggest the presence of trace metal containing waste components.

Groundwater

Supplemental RI results indicate that volatile organic groundwater contamination exists in the overburden throughout most of the Wildwood Conservation Corporation property. The principal groundwater contaminants are the volatile halogenated species trichloroethene and 1,2-dichloroethene. Generally lower concentrations of 1,1,1-trichloroethane, chloroform, xylene and ethylbenzene are also observed. Table 5-3 and Table E-13, Appendix E list the analytical results of the groundwater sampling.

Overburden groundwater contamination of volatile organics at the Wildwood Conservation Corp. property is highest in the vicinity of wells BSSW6 (TCE = 190,000 ug/l), S78S (TCE = 57,000 ug/l), and BOW14 (DCE = 4,508 ug/l). Concentrations of volatile organics are lowest at S95D (4.4 ug/l) and at BSW7 (<5 ug/l).

Several semivolatile compounds including bis(2-ethylhexyl)-phthalate, naphthalene, and 1,2-dichlorobenzene were detected in one or more groundwater samples. Concentrations of all semivolatile constituents were, however, less than 20 ug/l. In addition, the pesticide chlordane was detected in one sample (BSSW6) at a low estimated concentration of 3 ug/l.

The results of dissolved (filtered) metal analyses of samples from wells BSW6, S95D and S78S indicate metal concentrations to be generally low. Specifically, concentrations of metals with Safe Drinking Water Act maximum contaminant limits (MCLs) including arsenic, barium, cadmium etc. were generally below their respective MCL values. Concentrations of dissolved iron were, however, variable and range up to 11,300 ug/l in the sample from well BSW6. Results of total (unfiltered) iron analyses of groundwater samples were also quite variable with reported concentrations ranging up to 67,400 ug/l. A comparison of the filtered and unfiltered sample results is included on Table E-14, Appendix E.

5.4 New England Plastics

Soil Gas

The soil gas survey conducted at the New England Plastics property indicated the presence of TCE and PCE in one sample at NE-1 shown in Table 5-1 and Figure 4-8 at concentrations of 0.11 ul/l and 9.5 ul/l, respectively. This sample was adjacent to an asphalt area. Samples from locations near NE-1, in the non-asphalt area, did not have detectable concentrations of TCE and PCE. Sample NE-1 may be indicative of localized contamination or represent the edge of a plume that extends under the asphalt.

Soil

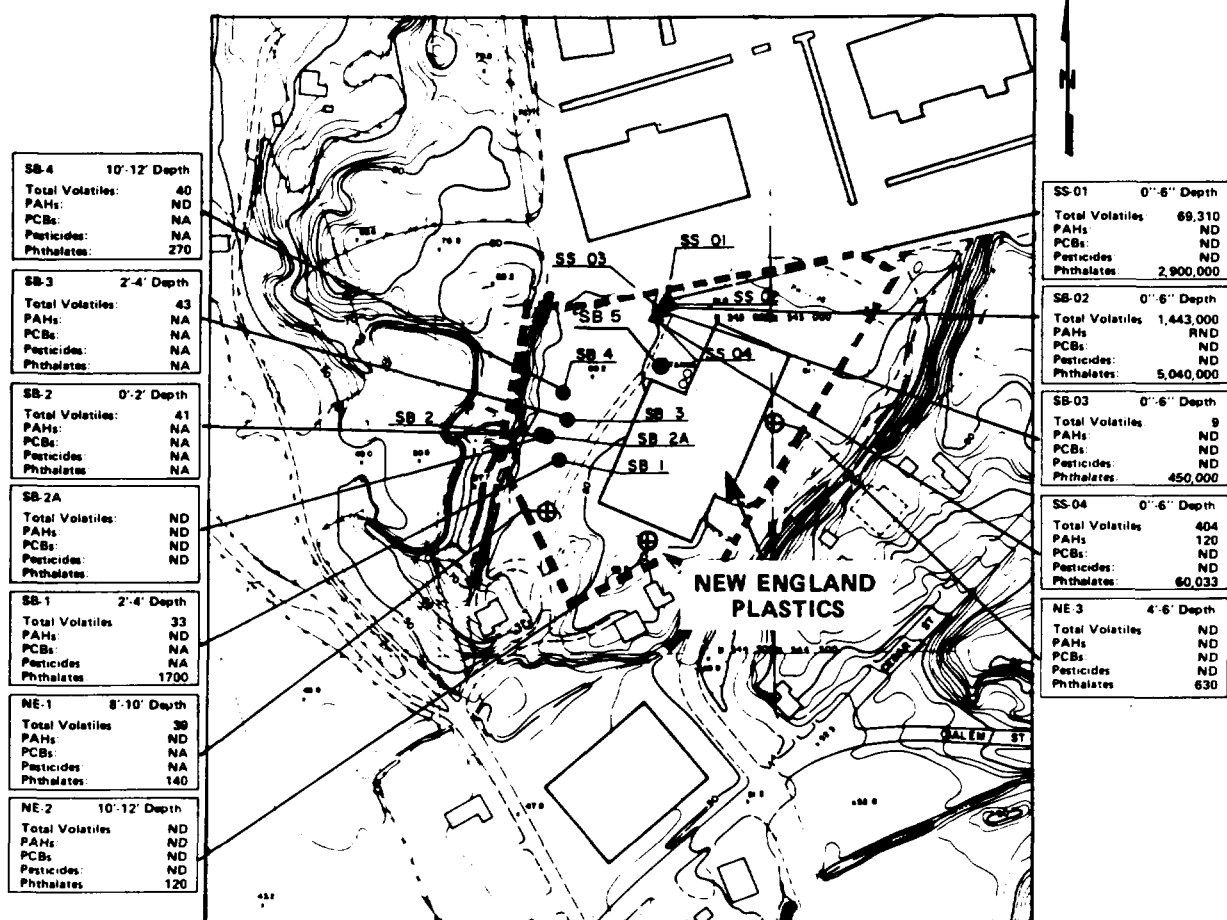
The New England Plastics property was not included in the previous RI investigations. Surface soil samples collected from this property during the supplemental RI (Figure 5-7 and Table E-15, Appendix E) were found to be contaminated with TCE, PCE, TCA, PAHs, PCBs and phthalates. The maximum concentration of PCE was 1,200,000 ug/kg at SS-02. Among the semivolatiles elevated concentrations of phthalates were observed particularly bis(2-ethylhexyl) phthalate (4,400,000 ug/kg) in sample SS-02. In addition, the PCB Arochlor 1260 was detected in sample SS-05 at 580 ug/kg.

Soil samples collected from subsurface soil borings and well borings generally showed levels of volatile organics less than 25 ug/kg (Tables E-16 and E-17). Semivolatiles in the borings occurred primarily as bis-(2-ethylhexyl) phthalate in well boring NE 3 (up to 630 ug/kg) at 4 to 6 feet and soil borings SB1 (1700 ug/kg) at 2 to 4 feet, SB4 (270 ug/kg) at 10 to 12 feet, and SB5 (7500 ug/kg) at 14 to 16 feet.

In general, metal concentrations (Tables E-15, E-16 and E-17) are within ranges often observed in soils (Conner and Shacklette, 1975). Concentrations of lead in samples SS-04 (289 mg/kg) and SS-05 (236 mg/kg) may, however, be slightly elevated in comparison to typical values (less than 200 mg/kg).

Groundwater

Six groundwater samples were collected from the New England Plastics property to characterize the extent and type of groundwater contamination (Figure 4-3). The three new wells were screened in the overburden and the three existing wells are deep bedrock wells. Groundwater data collected from the New England Plastics property is presented in Table E-18, Appendix E.



- SB 1 - SOIL BORING LOCATION AND NUMBER
 ⊕ NE 1 - WELL BORING LOCATION AND NUMBER
 ▲ SS 01 - SURFACE SOIL LOCATION AND NUMBER
 --- PROPERTY BOUNDARY

ND - NOT DETECTED
 J - ESTIMATED CONCENTRATION

Displayed sample concentrations have been selected to represent area wide distribution of contamination.

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 5-7

NEW ENGLAND PLASTICS PROPERTY
SOIL CONCENTRATIONS (ug/kg)

EBASCO SERVICES INCORPORATED

A groundwater elevation contour map for the New England Plastics property, constructed from data obtained at the time of groundwater sampling is presented in Figure 5-8. Groundwater elevation and depth to water data are listed in Table A-4, Appendix A.

Volatile organic compounds were present in all six wells at concentrations ranging from 9 ug/l to 416 ug/l (total volatile organics). The predominant compound found in the highest concentrations and in five of the six wells was tetrachloroethene (PCE). Concentrations of PCE ranged from below detection limits (No. 3) to 330 ug/l (No. 2) in the bedrock and between 9 ug/l (NE-2) and 96 ug/l (NE-1) in the overburden wells.

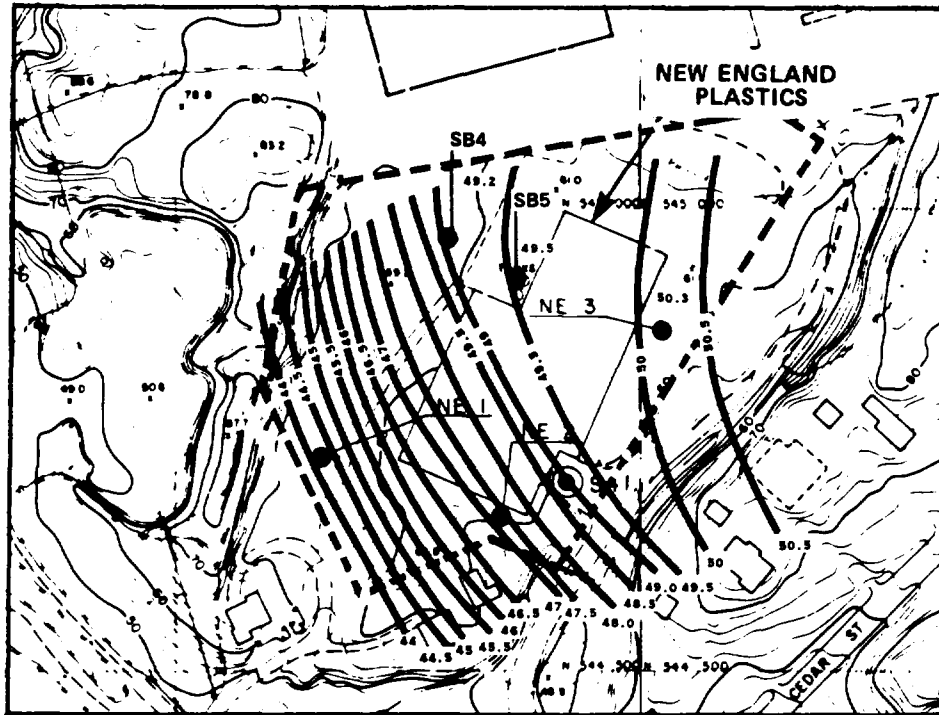
The results of dissolved (filtered) metal analyses performed on groundwater samples NE1-01 and NE2-01 indicated metal concentrations to be relatively low. Specifically, the concentrations of metals with Safe Drinking Water Act (50 Federal Register 46902, 1985) maximum contaminant limits (MCLs) including arsenic, barium and cadmium, etc. were generally below their respective MCL values. In addition, dissolved concentrations of iron and manganese were for both samples less than 50 ug/l. Total (unfiltered) concentrations of iron and manganese in samples from these locations were more than an order of magnitude higher. A comparison of filtered and unfiltered samples is presented in Table E-19, Appendix E.

5.5 Unifirst Corporation



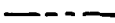
Although not strictly part of the Supplemental RI investigation, certain data relating to the Unifirst property has been compiled and is presented in this section. These data have been included to enhance and more effectively characterize overall chemical contaminant trends in the Wells G&H site area.

Soil

Soil boring samples collected by EPA at well locations shown in Figure 5-9 revealed the presence of several volatile organic compounds. PCE was detected 61 ug/kg at UC7, 0-1 feet deep; 170 ug/kg at UC5, 0-2 feet deep; and 290 ug/kg at UC17, 2-5 feet deep. Additional compounds found in the soil at less than 20 ug/kg included hexane (UC4, UC5, UC6, and UC7), toluene (UC5), and 1,1,1-trichloroethane (UC5). Generally, the contaminants were detected at depths of 0-6 feet. Soil data collected by EPA from Unifirst is presented in Table E-20, Appendix E.



100 0 100 200 300 400 500 FEET

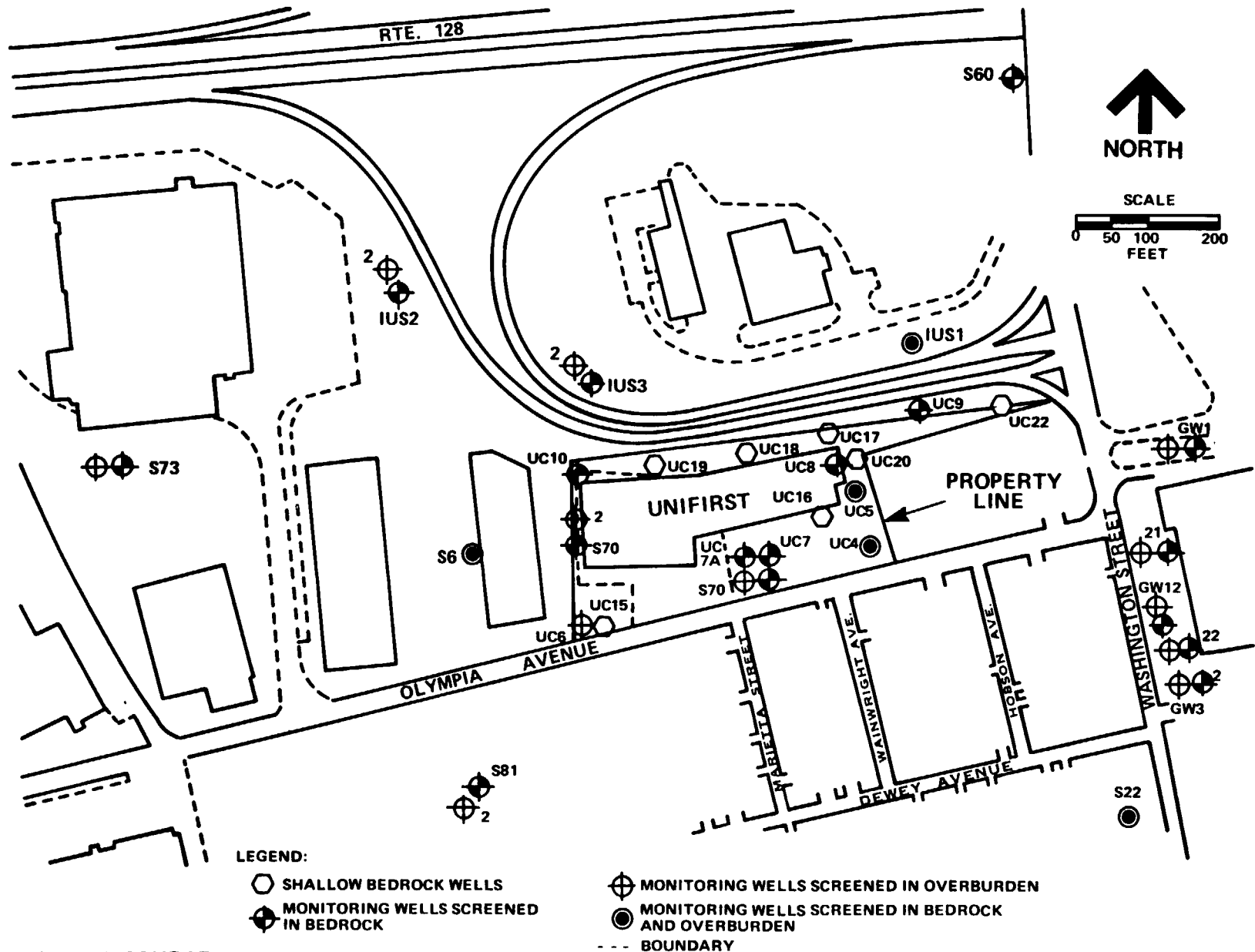
-  GROUNDWATER ELEVATION
CONTOUR IN FEET
ABOVE MEAN SEA LEVEL
 NE1 WELL LOCATION
AND NUMBER
 PROPERTY BOUNDARY

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 5-8
NEW ENGLAND PLASTICS PROPERTY
GROUNDWATER ELEVATIONS - 1987

EBASCO SERVICES INCORPORATED



BASE MAP SOURCE:
ERT PROJECT OPERATION PLAN
AUGUST, 1987

FIGURE 5-9 UNIFIRST PROPERTY WELL LOCATIONS

Groundwater

Seventeen wells were sampled on the Unifirst property by their consultants, ERT and by EPA. Fourteen of the wells are bedrock wells, two (UC4, UC5) are screened in both the bedrock and the overburden, and one well (UC6) is screened only in the overburden. Nine of the bedrock wells (UC7, UC7A, UC9, UC10, UC11, UC12, UC13, UC14, and UC21) are equipped with Solinst Multi-port sampling devices. ERT groundwater data is presented in Table E-21, Appendix E.

Wells (UC4-UC6) were sampled by ERT three times during 1986-1987. Analytical results from these wells indicate the presence of numerous volatile organic compounds, including PCE and TCA. Levels of PCE ranged from 33 ug/l (UC4, sample date 11/30/87) to 2576 ug/l (UC5, sample date 12-8-86). Levels of TCA ranged from non-detected (UC4 and UC6) to 1300 ug/l (UC5, sample date 2-4-87). Samples collected in December 1986 also revealed the presence of carbon tetrachloride in well UC5 (140 ug/l).

Bedrock wells equipped with the multi-port sampling devices were sampled by ERT three to four times during 1986-1988. The multi-port devices permitted the sampling of discrete zones within the bedrock to depths of 243 feet. Analytical results from these wells indicate the presence of volatile organic compounds, principally PCE, TCE, DCE and TCA. These compounds were detected at several wells at concentrations up to 17,000 ug/l (PCE, well UC7-2). In addition, many of these compounds were found at depths of 100-200 feet.

The remaining bedrock wells at the Unifirst property (UC8, UC15-UC20) also showed significant levels of volatile organic contamination. Analyses from November 1987 indicate the presence of PCE in wells UC15 (17,000 ug/l), UC16 (2,600 ug/l), UC17 (1300 ug/l), UC 18 (4,300 ug/l) and UC20 (85 ug/l). Well UC20 also contained TCA (11 ug/l), DCE (2.0 ug/l) and 1,1 dichloroethane (6.2 ug/l). Well UC16 also contained 1,1,1 TCA at a concentration of 280 ug/l.

Six samples of groundwater were collected by ERT from UC8 in January 1988. Well UC8 was found to contain dense non-aqueous phase liquid (DNAPL) by EPA in November 1987. Analysis of the DNAPL removed from well UC8 showed the DNAPL to be essentially 100% PCE. The presence of the DNAPL suggests that a spill of "free product" had occurred in this vicinity of the property. Analyses of groundwater samples from Well UC8 in January 1988 indicated the presence of PCE at concentrations ranging from 10,000 ug/l to 840,000 ug/l. Also found at this location were TCE (800-63,000 ug/kg) and trans 1,2-dichloroethene (0-76,000 ug/l). Results of these samples are included in Table E-2, Appendix E.

EPA also collected a round of groundwater samples from the Unifirst Property wells in 1987. Comparison of these data to that of ERT generally shows good agreement. Areas of significant contamination based on ERT results (i.e., wells UC5, UC7, UC9, UC10, UC15-UC18) generally agree with those established from EPA data. Moreover, zones characterized by little or no contamination (UC4, UC6, UC19) by ERT are similar to those of EPA. EPA groundwater data is presented in Table E-22, Appendix E.

Two offsite wells (UC-11, UC-12) just south of the Unifirst Property were sampled by ERT for Ebasco in November 1987. Samples were packaged by Ebasco and delivered to the CLP for analysis. Both wells were equipped with multi-port sampling devices. Organic contaminants present in UC-11 include TCE, PCE, and DCE (Table E-23, Appendix E). These contaminants were only present in UC-12 in part UC-12-3, and at concentrations less than 2 ppb. Inorganic constituents present in UC-11 and UC-12 included aluminum, calcium, magnesium and sodium.

5.6 Central Area

Surface Water/Sediment

Surface water and sediment samples were previously collected from the Aberjona River during the Part I RI. The samples were analyzed for volatile organics only. The highest levels detected in the surface water were from the western branch of the Aberjona River, just south of Olympia Nominee Trust. During May 1985, trans-1,1-DCE and TCE were detected at concentrations of 21 and 26 ug/l. In addition, less than 10 ug/l of 1,1,1-TCA was detected in any samples. Sediment samples were only screened for volatiles. Detectable levels of TCE were found in upstream sediment samples in the previous RI.

Tables E-24 and E-25 (in Appendix E) present the surface water/sediment sample results from this Supplemental RI. Figure 4-10 shows the locations of samples in the Aberjona River, drainage ditches and tributaries. The surface water samples showed detectable levels of volatile organics. Several TCL volatile organics including 1,1,1-TCA, 1,1 dichloroethane, and trichloroethene were detected in low concentrations ranging up to 2 ug/l at the SW-01, SW-02 and SW-03 sampling locations. In addition, low levels of trichloroethene were also detected at the SW-06 (0.7 ug/l) and SW-08 (0.5 ug/l) sampling locations.

Several phthalates including bis(2-ethylhexyl) phthalate and di-octyl-n-phthalate were also detected at concentrations of up to 100 ug/l. However, since these phthalates are common laboratory contaminants and were also detected in QC blanks the extent of their actual presence in Central Area surface waters is uncertain.

The surface water samples showed varying levels of TCL inorganics (Table E-25). Several metals including beryllium, cadmium, chromium, cobalt, mercury, nickel, selenium, silver and thallium were not detected (see Appendix A, Table A-2 for detection limits). Levels of arsenic and lead generally ranged from 2-20 ug/l. Concentrations of iron ranged from approximately 1000-5000 ug/l, calcium from 9000-35,000 ug/l, and sodium 13,000-53,000 ug/l. Cyanides were not detected in any of the surface water samples.

River sediment samples showed detectable levels of several TCL volatile and semivolatile organics (Table E-24). Several volatile halogenated organics (VHOs) including trichloroethene were detected in samples SD-02, SD-05, SD-06 and SD-08 at concentrations generally ranging from 1-9 ug/kg. In addition, toluene was detected in SD-02, SD-04, SD-05 and SD-06 and benzene was detected in SD-02, at concentrations ranging from 1-5 ug/kg.

A variety of semivolatile PAH compounds were detected in several sediment samples including SD-01, SD-02, SD-03, SD-05 and SD-08. The highest detected concentrations of several PAHs including fluoranthene (8151 ug/kg), pyrene (7228 ug/kg) benzo-a-anthracene (4182 ug/kg) and benzo-a-pyrene (3665 ug/kg) were detected in the SD-08 sample. PAH concentration distributions appeared to be skewed toward the higher molecular weight species. Concentrations of the lower molecular weight PAH naphthalene reached a maximum value of 292 ug/kg (SD-08).

Highest levels of total PAHs (44,763 ug/kg) were detected in the sediments at Location SD-08 south of the Salem St. bridge at the southern boundary of the site. PAHs were detected upstream of the site at SD-01 at a total PAH concentration of 3,628 ug/kg. PAHs were largely absent from one drainage ditch near Olympia (i.e., SD-04).

The results of TCL inorganic analyses indicated that the sediment concentrations of certain metals varied widely. In particular, the concentrations of arsenic (3630 mg/kg), chromium (1250 mg/kg), copper (3010 mg/kg) and lead (1190 mg/kg) in the SD-06 sample were all more than an order of magnitude greater than the upstream concentrations for these metals measured at SD-01. The maximum concentrations of most other TCL metals including mercury (27 mg/kg) and zinc (5170 mg/kg) were also observed at the SD-06 location.

Four sediment samples and one surface soil sample (SD-09, SD-10, SD-11, SS-17) collected south of Salem Street were also analyzed for dioxin. Results indicate that dioxin, in the octachloro form (OCDD), was detected in one sample at SD-11 at 6.6 ng/g. Results are presented in Table E-26, Appendix E.

A second round of sediment samples were collected in the Aberjona River in June 1988 to further determine the extent of contamination. Sediment samples were collected at thirteen locations shown in Figure 4-11. The data tabulated in Table E-27, Appendix E indicates essentially the same contaminants although somewhat lower maximum concentrations as the first round. The sediments are primarily contaminated with arsenic, lead and mercury in localized "hot-spot" areas with the highest area of overall inorganic contaminant concentrations in the previously sampled areas of SD-6 and SD-8. The CN sample notation of Table E-27 and Figure 4-11 replaces the SD notation in Table E-25 of Figure 4-10.

Sewer Composite Samples

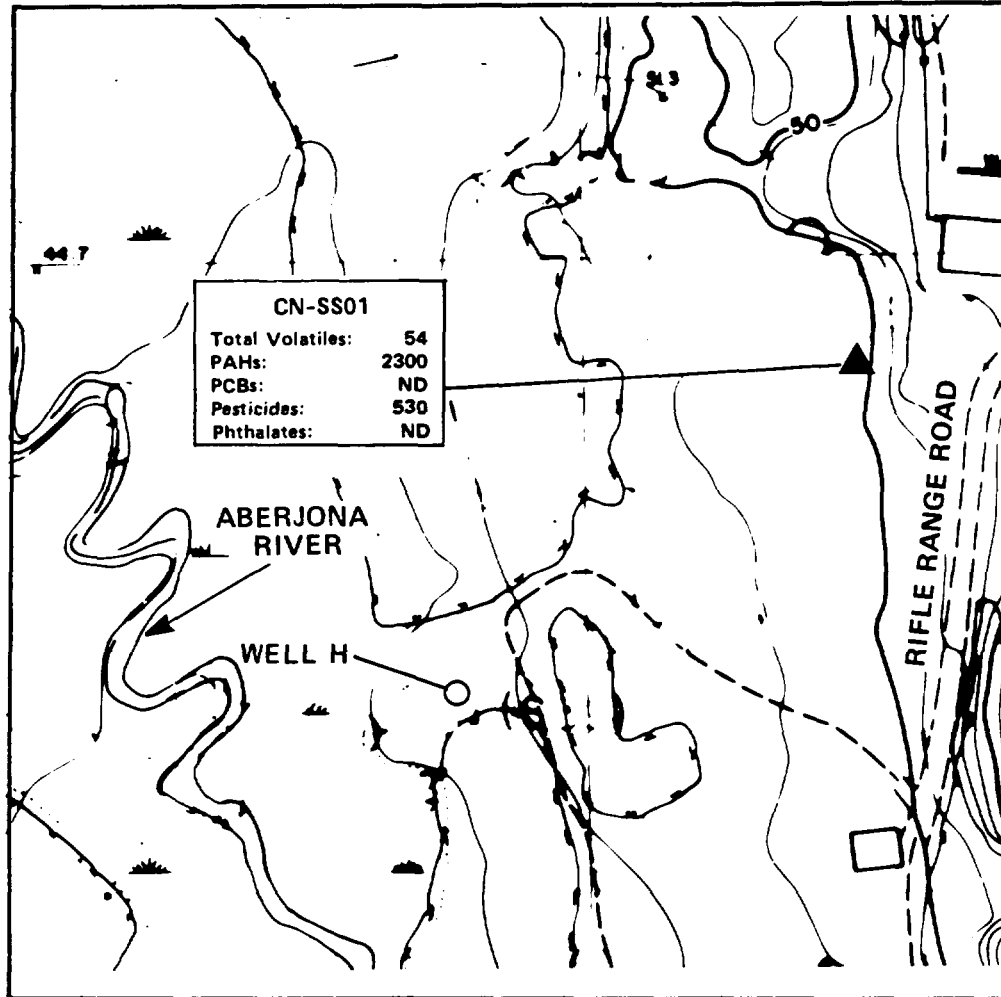
Two sewer composite samples were collected from both the City of Woburn sewer line and the MWRA sewer line. The City of Woburn sewer line sample was obtained from a manhole located in the southern portion of the Olympia Property. The MWRA sewer sample was obtained from a manhole on the Wildwood Property. A summary of the results of the two sewer composite samples is shown in Table E-28. Chemical contaminants in the sewer flow included acetone (1000 ug/l), 2-butanone (290 ug/l) toluene (110 ug/l), 1,1,1-TCA (63 ug/l) and TCE (1 ug/l) and PCE (1 ug/l) for the City of Woburn sewer which was sampled at the manhole on the Olympia property. Constituents in the MWRA sewer sampled at the manhole on the Wildwood property included toluene (28 ug/l), 1,1,1-TCA (20 ug/l), TCE (14 ug/l) and PCE (27 ug/l).

Samples of the sewer were analyzed for a number of conventional parameters as shown in Table E-29. The City of Woburn sewer had a higher concentration of total organic carbon (495 mg/l) compared to the MWRA sewer (100 mg/l) and also higher oil & grease (95 mg/l) versus 42 mg/l for the MWRA sewer. Chloride and sulfate concentrations were higher in the MWRA sewer (520 and 240 mg/l, respectively) compared to the City of Woburn sewer (160 and 53 mg/l). The conventional parameter concentrations for both sewers appear to be within the typical range for combined sanitary/industrial wastewaters.

Soil samples adjacent to sewer manhole covers on the Olympia and Wildwood properties were also collected as discussed in the Olympia and Wildwood property sections of this report.

Soils

Soil contamination was not thought to be present in the Central Area based on past knowledge of the site. At the request of EPA only one soil sample was collected in the Central Area based on visual evidence of soil staining. This location is shown in Figure 5-10 near the Rifle Range. This sample was collected from a small area (10 square feet) that had a black stained



100 0 100 200 300 FEET

ND - NOT DETECTED

U.S. ENVIRONMENTAL
PROTECTION AGENCY

WELLS G & H

FIGURE 5-10
CENTRAL AREA (RIFLE RANGE)
SURFACE SOIL CONCENTRATIONS (ug/kg)

EBASCO SERVICES INCORPORATED

appearance at the surface. Chlordane (530 ug/kg) and pyrene (2,300 ug/kg) were the only organic contaminants present. Soil inorganic concentrations in the Rifle Range sample do not appear to be elevated in comparison to other Central Area soils. Central area soil data is presented in Table E-30, Appendix E.

Groundwater

Twenty Central Area wells, all located within the limits of the Wells G&H site, were sampled during the Supplemental RI to help characterize groundwater contamination. Seventeen of the twenty wells are screened in the overburden; three wells are shallow bedrock wells. A groundwater elevation contour map of the site area, constructed from data obtained at the time of groundwater sampling, is presented in Figure 5-11. Groundwater elevation and depth to water data are listed in Table A-4, Appendix A.

Analytical results from Table E-31 indicate the presence of many volatile compounds, including TCE, PCE, and DCE. TCE was found in concentrations up to 180 ug/l (well S77D), PCE levels ranged up to 790 ug/l (well S81S), DCE was found in concentrations up to 28 ug/l (well S68S), and 1,1,1 TCA up to 150 ug/l in S81S (see Table 5-3).

Only a few semivolatile constituents including n-nitrosophenylamine (S88M-01, 21 ug/l; AB1-01, 28 ug/l; and AB-1-02, 26 ug/l) and several phthalates in concentrations up to 210 ug/l were detected.

Analytical results also indicated the presence of volatile organic compounds in some Central Area bedrock wells. Specifically, well S81D was found to contain PCE (180 ug/l), TCE (5 ug/l), and 1,1,1-TCA (13 ug/l), while well S73D contained TCE (10 ug/l), DCE (17 ug/l), and 1,1-dichloroethane (5 ug/l). A third bedrock well (S74D) contained no volatile organic contamination. None of the Central Area bedrock wells were analyzed for semivolatile compounds or inorganics.

Three additional Central Area overburden groundwater samples were collected south of the Wells G&H site (i.e., south of Salem Street). Analytical results indicate the presence of TCE (47 ug/l), PCE (55 ug/l), and 1,1,1-TCA (21 ug/l) in well S11. No volatile organics were detected in S10. S45 contained only 2 ug/l PCE. One sample and a duplicate sample were collected at Riley Well #1 (S-47). All compounds (volatiles, semi-volatiles and, inorganics) were either not detected or at very low concentrations. Results are presented in Table E-31, Appendix E. Six wells in and around Central Areas (S-72S, S-81S, S-84S, S-77S and S-22) were sampled for the radionuclides total radium, total uranium and gross alpha and beta. Results are presented in Table E-31, Appendix E. Analytical results indicate that most of the levels are within acceptable concentration ranges with the exception of the sample from well S-22 which is elevated relative to the other samples for all radionuclides except total uranium.

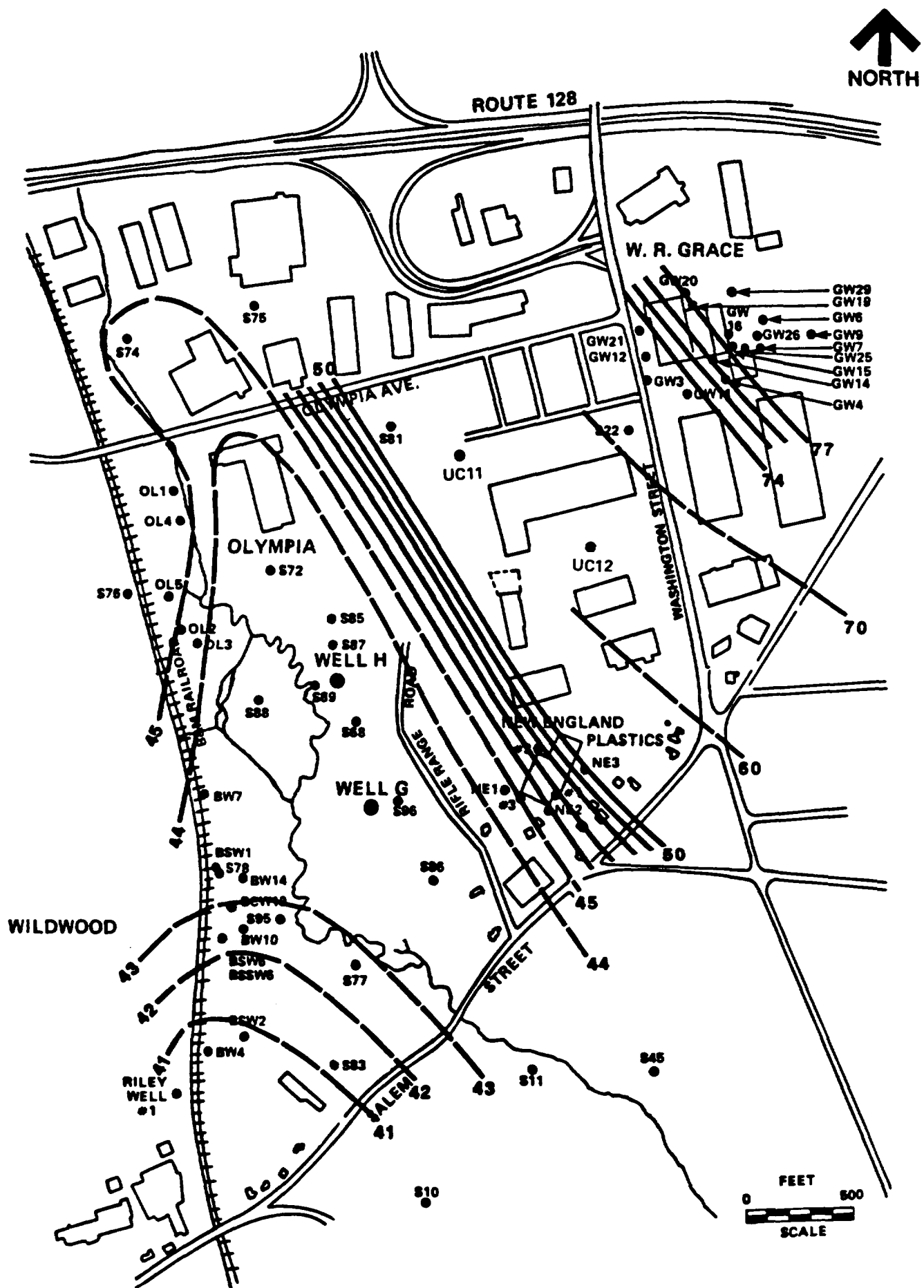


FIGURE 5-11 ELEVATION OF GROUNDWATER IN THE VICINITY OF THE WELLS G&H SITE. OCTOBER-DECEMBER, 1987

5.7 Air

Volatile organic compounds detected in the soils at the Wells G & H Site can volatilize and be released to the air. Conditions at the Unifirst Corporation property do not favor air release because the property is primarily paved. Air monitoring during the supplemental RI using FID and PID detectors showed no air quality readings above background levels at any of the properties. Air emissions were only detected above background during drilling of certain soil borings and sampling of certain monitoring wells.

5.8 Summary of Groundwater Treatability Study

Environmental Science and Engineering, Inc. (ESE) was subcontracted by Ebasco Services Incorporated (Ebasco) to perform a treatability study on contaminated groundwater from the Wells G and H site. Three wells were sampled for testing, two on the Wildwood property and one downgradient of the Unifirst property. The wells were sampled by Ebasco between January 25 and February 11, 1988. The samples were delivered to ESE personnel onsite for treatability testing on February 9, 10, and 11, 1988. The treatability testing was conducted in an onsite mobile treatability laboratory. The two wells on the Wildwood property, BOW 14 and BSSW6, were composited by ESE as advised by Ebasco at a ratio of 3.2 to 1, respectively. The Unifirst groundwater sample tested was collected from Well 81S to the southwest of the Unifirst property. A groundwater sample from BSSW6 and S81S (including a duplicate at this well) were sent to the CLP for conventional parameter tests. Results are presented in Table E-33, Appendix E.

The primary purpose of the treatability study was to gather information on selected treatment technologies and their applicability to remediation of contaminated groundwater at the Wells G & H site. Information was developed to evaluate the effectiveness, technical feasibility and cost of treatment technologies to remove metals, volatile organic compounds (VOCs), and semi-volatile organic compounds from two groundwater sources. The treatability study included: groundwater characterization (conducted by Ebasco), evaluation of physical-chemical pretreatment, evaluation of air stripping, and, evaluation of carbon adsorption.

Physical-chemical treatment processes were evaluated for the removal of divalent metals (principally iron and manganese) and oil and grease. The conventional treatment processes tested in this study included: chemical coagulation, flocculation, settling, oxidation and acidification. Chemical treatment using alum, ferric chloride, lime, sodium hydroxide, and potassium permanganate were tested.

Less than 1 milligram per liter (mg/l) of oil and grease was found in both groundwater samples; therefore, the Dissolved Air Flotation (DAF) tests were not needed. Bench-scale air stripping and carbon adsorption tests were conducted to evaluate the removal of VOCs to achieve tentative treatment goals, the National Secondary Drinking Water Regulations (NSDWR) maximum contaminant levels (MCLs) promulgated in the Federal Register, July 8, 1987.

Based on the results of the Unifirst groundwater air stripping test, it was demonstrated that the VOCs were significantly reduced. The bench-scale diffused air stripping test defined the least-strippable VOCs on which to base an air stripping column design. Through the implementation of the theoretical air stripping model it was demonstrated that a feasible air stripping column could be designed to reduce individual VOCs to 1 ug/L. Pretreatment was not needed for the Well S-81 sample tested due to the low concentrations of iron and manganese in the sample.

For the Wildwood Conservation Corporation groundwater tests it was demonstrated that VOCs and semivolatiles could be reduced to below the limits of detection in the final effluent. It was also shown that pretreatment of the Wildwood groundwater composite reduced iron and manganese below tentative treatment goals. The air stripping test on the Wildwood groundwater composite provided information similar to that described in the preceding paragraph on a feasible design for removing VOCs. The carbon adsorption isotherm tests demonstrated that carbon adsorption was effective at polishing or removing trace levels of VOCs in the water effluent from the air stripping test. After lime precipitation pretreatment of the Wildwood groundwater, it was recommended that recarbonation or adjusting the pH to about 8.6 be included prior to air stripping to remove excess calcium.

The treatability study results showed that groundwater treatment should include pretreatment by lime precipitation followed by recarbonation, filtration, and air stripping. Carbon adsorption was not needed to meet MCLs for the samples evaluated.

5.9 Field Blanks and Trip Blanks

QA/QC sample results are found in Table E-34 at the end of Appendix E. No significant levels of organics were present in the blanks indicating that there was no contamination of the samples during sample collection or sample shipment/handling.

5.10 Fate and Transport of Groundwater Contaminants

A comparison of the 1985 and 1987 groundwater quality data is presented in Table E-35 for each of the wells for which comparative sampling results were available from the 1985 RI and the

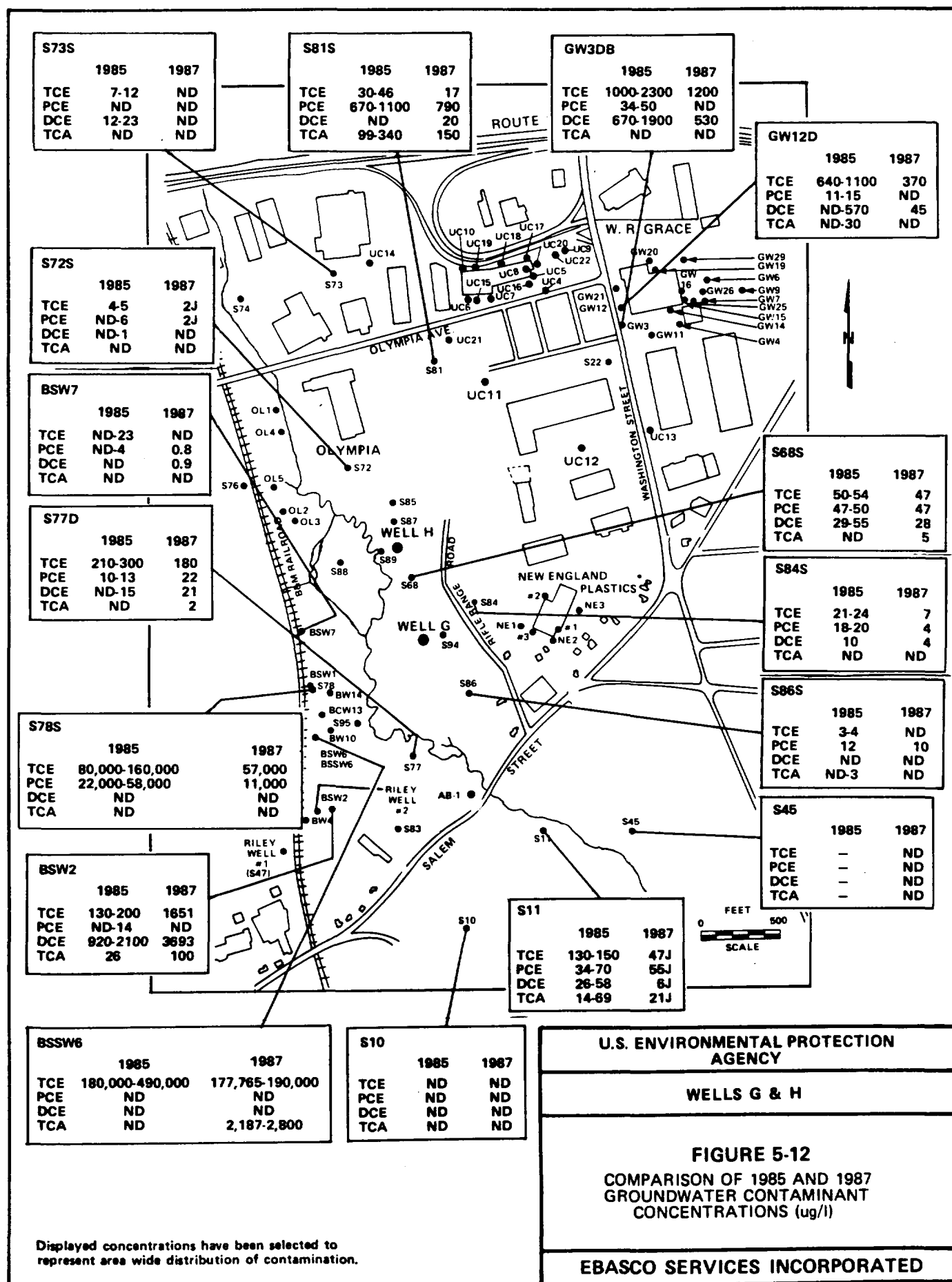
1987 Supplemental RI. This comparison can be made for 33 wells located throughout Wildwood Conservation Corporation, W. R. Grace, Unifirst Corporation and the Central Area of the aquifer. There is no 1985 data available at the Olympia Nominee and New England Plastics properties to make any comparison for these areas of the site.

Figure 5-12 shows a comparison of the 1985 and 1987 data for selected wells. This comparison indicates that contaminant concentrations for certain compounds in 1987 in most areas of the site are within the ranges of the 1985 sampling data. No significant migration of groundwater contamination is apparent downgradient of the site to the south of Salem Street as evidenced by the volatile organic concentrations in Well S-11 which have decreased since 1985 and the fact that contaminants are not detected in wells S-10 and S-45 south of Salem street.

Contaminant concentrations at the Wildwood property have essentially remained the same in the high concentration area at well BSSW6. TCE and DCE concentrations have increased at well BSW2 to the south of BSSW6 suggesting localized downgradient migration. Contaminant concentrations in well S77D are approximately the same as 1985 indicating that the plume has not increased in this area. It appears that the Riley Well No. 2 operating to the southwest of this area may be contributing to the lack of any significant downgradient off-property migration to wells S83 and S10. Vertical migration of contaminants downward to the bedrock as evidenced from the historic groundwater data, and chemical transformations of TCE to DCE to vinyl chloride may explain the changes in contaminant concentrations in some areas of the Wildwood property and the rest of the site area.

Contaminant concentrations reported in the 1987 data for the W. R. Grace property are similar to those reported in 1985 as evidenced by the data at Wells GW-3S, G11S and G11D (see Table E-35). Slight decreases in concentrations at GW3DB and GW12D are also evident.

The contaminant concentrations in the Central Area of the site near Wells G&H are again very similar to those reported in 1985 as evidenced by the data from Wells S68S, S72S, S81, and S85. Slight reductions in contaminant concentrations appear to have occurred in the Central Area of the site from 1985 to 1987 at wells S84S and S86S.



6.0 SUMMARY OF INVESTIGATIVE FINDINGS

This section presents an overall summary of the extent of soil and groundwater contamination at each of the properties and in the Central Area of the Wells G&H site. As mentioned previously, the reference to property ownership is only done to facilitate presentation of data and is not meant to delineate liability for the purpose of CERCLA, as amended.

6.1 Olympia Nominee Trust

The contaminants which were detected in soil samples from the property included volatile organics, PAHs phthalates, and pesticides. Maximum observed contaminant concentrations in the soil were 19 ug/kg TCE, 9 ug/kg PCE, 6375 ug/kg PAHs, 89 ug/kg phthalates, 240 ug/kg DDT, 88 ug/kg DDE and 38 ug/kg DDD.

Heavy metal constituents were present in soils at varying levels including maximum concentrations of 139 mg/kg arsenic, 924 mg/kg chromium, 4.2 mg/kg mercury and 3.0 mg/kg cadmium. The depth of soil contamination ranges from 0-6 feet.

Groundwater contamination at the Olympia Nominee Trust property is present in the overburden at most of the wells but specific chemical contamination does not appear to be widespread throughout the property. Elevated concentrations of TCE are present in Well OL2 (3400 ug/l) and Well OL3 (180 ug/l). Well OL4 contained the volatile compounds, benzene and total xylenes at 16 ug/l and 10 ug/l, respectively, and the semivolatile organic, naphthalene (120 ug/l). Well OL1 contained xylene (29 ug/l) and ethylbenzene (5 ug/l).

Heavy metal concentrations in the groundwater were quite variable at the Olympia Nominee Trust property when comparing filtered with unfiltered data. Maximum total (unfiltered) concentrations of several heavy metals including arsenic (574 ug/l), chromium (1220 ug/l) and lead (224 ug/l) were elevated and believed to be the result of high turbidity in the well samples. Supplemental sampling and analysis of filtered samples showed concentrations of chromium and lead both below detection limits. The maximum iron and manganese concentrations were 6040 ug/l and 4130 ug/l, respectively. The highest arsenic concentrations in the filtered samples was 20.1 ug/l.

6.2 W.R. Grace & Company

Soil samples collected during the Supplemental RI to confirm the effectiveness of soil remediation efforts performed by the property owner in 1985 indicated the presence of relatively low

maximum levels of organics including 1,1,1 TCA (11 ug/kg), chloroform (4 ug/kg) and DDT (24 ug/kg) and phthalates 3 ug/kg. Metals were present in the soil at varying concentrations with up to 18 mg/kg of arsenic, 33 mg/kg chromium, and 0.4 mg/kg mercury detected.

Volatile organic groundwater contamination exists in both the overburden and bedrock aquifer at this property. Contaminants whose maximum detected concentrations exceeded 1000 ug/l included TCE (2800 ug/l), vinyl chloride (3600 ug/l), toluene (3600 ug/l) and DCE (7300 ug/l).

Maximum total groundwater metal concentrations were 10 ug/l arsenic, 24 ug/l chromium, and 18 ug/l lead. Iron and manganese were present at maximum levels of up to 7,730 ug/l and 14,300 ug/l, respectively.

6.3 Wildwood Conservation Corporation

This property contains the most extensive area of contaminated soil and the highest concentrations of contaminants anywhere within the Wells G&H site. Essentially all of the contaminant organic chemical groups of concern including, volatile organics, PAHs, PCBs, pesticides, and phthalates were present. Certain inorganic contaminants including arsenic, chromium, mercury and cadmium were also present. Maximum contaminant concentrations exceed 10,000 ug/kg for total volatile organics, PCBs, chlordane and phthalates. Maximum heavy metal concentrations include 60.7 mg/kg arsenic, 3060 mg/kg chromium, 5.5 mg/kg mercury, 27.2 mg/kg cadmium, 683 mg/kg lead and 1240 mg/kg zinc. The depth of soil contamination ranges from zero to four feet.

Sludge and debris areas at the site contained high levels (in excess of 100,000 ug/kg at SL-08) of volatile organics, PAHs, phthalates and pesticides. The sludges also contained several heavy metals at concentrations of up to 86 mg/kg arsenic, 802 mg/kg chromium, and 10,000 mg/kg lead.

The Wildwood Conservation Corporation property also generally represents the area of highest groundwater contamination at the Wells G&H site. Overburden volatile organic aquifer contamination is high throughout most of this property with maximum concentrations of TCE (190,000 ug/l) in Well BSSW6. Chloroform, PCE, 1,1,1 TCA, ethylbenzene, total xylene and DCE were also present at maximum concentrations of greater than 1000 ug/l.

Groundwater volatile organic contamination also exists in the fractured bedrock. This is evident by the levels of TCE detected in bedrock wells BW9 (6727 ug/l), and BW10 (291 ug/l).

6.4 New England Plastics

Surface soil samples in a small 10 square foot area in the rear of this property were found to be contaminated with TCE, PCE, 1,1,1-TCA, PAHs, PCBs and phthalates. The maximum concentrations which were observed were 110,000 ug/kg TCE, 13,000 ug/kg 1,1,1-TCA, 120 ug/kg PAHs, 580 ug/kg PCB and 5,040,000 ug/kg phthalates. Subsurface soil boring samples, collected west of the building showed much lower volatile organic concentrations, less than 25 ug/kg, however, phthalates were detected as high as 7500 ug/kg.

Groundwater at this property was found to be contaminated in both the overburden and bedrock aquifers. The primary contaminant (PCE) was found to be present in the overburden wells at concentrations as high as 96 ug/l and in the existing bedrock wells at concentrations as high as 330 ug/l.

6.5 Central Area

One sample was collected in the Central Area of the site in the vicinity of the abandoned Wells G&H where one area of discolored soil adjacent to the Rifle Range parking lot was discovered. The soil in this area was found to be contaminated with chlordane at 530 ug/kg and pyrene (2300 ug/kg).

The groundwater in the central area was found to be contaminated with volatile organics. Overburden contamination included TCE, PCE, DCE at maximum concentrations as high as 180 ug/l TCE in Well S77D, 790 ug/l PCE in Well 81S, and 21 ug/l DCE in Well S77D. Bedrock contamination included 180 ug/l PCE at Wells 81D, 10 ug/l TCE in Well S73D, and 17 ug/l DCE and 5 ug/l 1,1-dichloroethane in Well S73D.

Surface water in the Aberjona River was found to be contaminated with the volatile organics 1,1,1-TCA and TCE at maximum concentrations of 2 and 1 ug/l, respectively.

The river sediments in this area were found to be elevated with respect to several metals particularly arsenic (3630 mg/kg), lead (1190 mg/kg) and mercury (27 mg/kg) at SD-06. Total PAHs of approximately 44,764 ug/kg were also detected at location SD-8 near Salem Street. Essentially the same contaminants were found in the upstream sediment samples at Location SD-1 at much lower concentrations.

A second round of sediment samples were collected in the Aberjona River in June 1988 to further determine the extent of contamination. Sediment samples were collected at thirteen locations. The results indicate essentially the same contaminants were detected although at somewhat lower maximum concentrations than the first round. The sediments are primarily contaminated with arsenic, lead and mercury in

localized "hot-spot" areas with the highest area of overall contaminant concentrations in the previously sampled areas around SD-6 and SD-8 and the newly sampled area around CN 5 to CN 10B.

6.6 Unifirst Corporation

Shallow soils at this property (i.e., 0 to 2 feet) were found by EPA, while overseeing well drilling at Unifirst, to be contaminated with PCE in isolated areas of the site near Wells UC-5, UC-7, and UC-17. Additional volatile organics also detected in site soils although at lower concentrations included hexane, toluene and 1,1,1-trichloroethane. The maximum concentration found was 290 ug/kg at UC-17.

Groundwater at this property has been found to be contaminated primarily with PCE in both the overburden and bedrock aquifers. The contamination is present at a maximum concentration of 2576 ug/l in the overburden in Well UC-5 and at a maximum concentration of 20,000 ug/l in the fractured bedrock at Well UC 7 at a depth of 76 feet. Contamination has been found to be present to depths of 240 feet at a PCE concentration of 13,800 ug/l at Well UC-21 which is downgradient of the property. Contamination also extends south of the property to UC11 primarily in the bedrock.

The source of the PCE contamination has been related to a possible spill of free product at Well UC-8 as indicated by the presence and recovery of a sample which had a concentration of essentially 100% PCE as measured by EPA in November 1987. Groundwater samples from well UC-8 showed a maximum PCE concentration of 840,000 ug/l. In addition other volatile organics including toluene and trichloroethane have been detected at certain locations in concentrations of less than 500 ug/l.

6.7 Conclusions

Based on the results of this Supplemental RI together with the previous RI work, the following conclusions were developed:

1. There are 5 groundwater contamination areas within the Wells G & H site. Several of these were identified in the Part I RI (NUS, 1986). The areas are as follows:
 - a northeast plume of predominantly TCE in both the overburden and bedrock aquifer at the W.R. Grace property
 - a northern plume of predominantly PCE in both the overburden and bedrock aquifer at the Unifirst property
 - a western area of predominantly TCE primarily in overburden at the Wildwood property

- TCE contamination in the overburden aquifer at the Olympia Nominee property.
 - an area of predominantly PCE contamination in both the overburden and bedrock aquifer at the New England Plastics property.
2. The USGS aquifer test (USGS, 1987) concluded that Wells G & H obtain water from an area of aquifer, or zone of contribution, that may be divided into two parts. Most water pumped by the wells is obtained from that part of the aquifer surrounding both wells and from induced infiltration of surface water from the overlying river and wetland. Water also is obtained from a small area south of the wells, and a limit can be determined which marks the dividing line between the area in which groundwater flows toward well G and the area in which ground water flows southward toward the river and toward the Riley well which is used by Riley Tannery as a production well for process water. The remaining part of the zone of contribution is that area of the Aberjona River drainage basin upgradient from and outside of the area of influence of wells G & H.
 3. The downgradient limit of the zone of contribution during the USGS aquifer test was located to the north of the Riley production well.
 4. The source areas identified within this Supplemental RI and previous RIs (i.e., W.R. Grace, Unifirst, Wildwood, Olympia Nominee and New England Plastics) all fall within the zone of contribution determined by the USGS aquifer tests. All these sources have contributed and are continuing to contribute to the groundwater contamination in the aquifer supplying water to Wells G & H.
 5. The source of the BTX groundwater contamination at the Olympia Nominee property appears to be related to either the Weyerhaeuser property northwest of Olympia property or to a leaking underground storage tank which was removed from the Olympia property (In the 1985 NUS RI, BTX contamination was discovered in a well on the Weyerhaeuser property).
 6. Additional investigation at the Unifirst property by their consultant since the Part I RI has determined that there is a high concentration of PCE in the deep bedrock on the property and downgradient. The source of the PCE has been determined to be an apparent spill of free product at Well UC-8 as indicated by its recovery from this well. The free product was found to be essentially 100% PCE.

7. Based upon a comparison of the groundwater sampling data for the 1987 Supplemental RI with the previous 1985 sampling data no significant migration of the groundwater contamination is apparent downgradient of the site to the south of Salem Street. In general, volatile organic concentrations in most areas of the site are within the range of values previously reported in the 1985 data except for increases in volatile organic concentrations in a few wells at the Wildwood Property and a slight reduction in the volatile organic concentrations in two Central Area wells.
8. Areas of contaminated soil have been identified by the Supplemental RI throughout the Wildwood property, and in localized areas at the New England Plastics, Unifirst Corporation and Olympia Nominee Trust properties. The primary soil contaminants at the above properties are volatile organics. However, PCBs, PAHs, phthalates and pesticides were also found.
9. The Supplemental RI soil data support the identified sources of the groundwater contamination. Soil data collected at the sources during the Supplemental RI showed that essentially the same volatile organic contaminants are present in both the soil and groundwater.
10. Aberjona River sediments were found to have elevated concentrations of metals and PAHs, in several locations.

REFERENCES

- Wells G & H Remedial Investigation Report, Part I, Woburn, Massachusetts. Prepared for the Region I U.S. Environmental Protection Agency, Waste Management Division. TDD No. Fl-8607-07, NUS Job No. MA11RF, EPA Site No. MAD980732168, Contract No. 68-01-6699. NUS Corporation (NUS). October 17, 1986.
- Wells G & H Remedial Investigation Part II. Final Report. Prepared for U.S. Environmental Protection Agency, Office of Waste Programs Enforcement. Contract No. 68-01-7037. Alliance Technologies Corporation (Alliance). November 1986.
- Connor, J.J., and H.T. Shacklette, Background Geochemistry of Some Rocks, Soils, Plants and Vegetables in the Conterminous United States, U.S. Geological Survey Professional Paper 574-F, 1975.
- The Safe Water Drinking Act, 50 Federal Register 46902, 1985.
- National Secondary Drinking Water Regulations, Washington D.C., Environmental Protection Agency (EPA). 1987.
- U.S. Geological Survey, 1987. Area of Influence and Zone of Contribution to Wells G and H, Woburn, Massachusetts, Water-Resources Investigations Report 87-4100.



UNIFIRST PROPERTY

	UC8	UC10-4	UC9-4	UC21-F	UC7-2	UC5
TCE	6.9	170	14	684	200	8
PCE	97	3,100	1000	13,800	17,000	1,500
1,2-DCE	ND	ND	23	46	390	ND
1,1,1-TCA	ND	66	48	25	1,400	620

W.R. GRACE PROPERTY

	GW3S	GW15S	GW20S	GW26S	GW15D	GW3DB
TCE	1,300	ND	2,800	5	280	1,200
PCE	35	ND	ND	ND	ND	ND
1,2-DCE	1,400	1,200	800	19	7,300	530
1,1,1-TCA	ND	ND	ND	ND	ND	ND

CENTRAL SITE PROPERTY

	S86D	S88S	S85	S81S	S81D	S11
TCE	3	47	23	17	ND	ND
PCE	14	47	110	790	ND	ND
1,2-DCE	ND	28	ND	20	ND	ND
1,1,1-TCA	ND	5	24	150	ND	ND

NEW ENGLAND PLASTICS PROPERTY

	NE1	NE2	NE3	S41 (No.1)	(No.2)	(No.3)
TCE	37	R	27	14	52	ND
PCE	96	9	84	65	270	ND
1,2-DCE	2	2	6	ND	11	ND
1,1,1-TCA	26	ND	5	3	17	ND

WILDWOOD CONSERVATION CORPORATION PROPERTY

	BSW2	BSSW6	BCW13	S78S	BW9	BW10
TCE	1,851	177,765	4,177	57,000	6,727	291.2
PCE	ND	ND	ND	11,000	ND	ND
1,2-DCE	3,693	ND	286	ND	ND	ND
1,1,1-TCA	100	2,187	ND	ND	154	6.2

OLYMPIA NOMINEE TRUST PROPERTY

	OL1	OL2	OL3	OL4	OL5	
TCE	ND	3,100	180	ND	ND	ND - NOT DETECTED
PCE	ND	41	45	ND	ND	R - REJECTED
1,2-DCE	ND	R	23	ND	ND	
1,1,1-TCA	ND	ND	ND	ND	ND	

NOTES:

1. BASE MAP FROM TOPOGRAPHIC MAPS FOR THE PLANNING BOARD, CITY OF WOBURN, MASSACHUSETTS GRID NOS. 12, 13, 16, 17 BY LOCKWOOD, KESSLER & BARTLETT, INC., 1986. PHOTOGRAPHED BY THE U.S. GEOLOGICAL SURVEY SEPTEMBER, 1985 BASED UPON EPA/EPIC AERIAL PHOTOGRAPH UPDATE APRIL, 1985.

2. THE FOLLOWING DESIGNATIONS APPLY TO THE INSTALLATION OF WELLS:

S1-22 EPA MONITORING WELLS INSTALLED BY ECOLOGY & ENVIRONMENT INC., 1981

S23-82 PREVIOUSLY EXISTING WELLS

S83-86 EPA MONITORING WELLS INSTALLED BY NUS CORPORATION, DECEMBER, 1984 - MARCH, 1985

S87-97 EPA MONITORING WELLS INSTALLED BY THE U.S. ARMY CORPS OF ENGINEERS, SEPTEMBER, 1985 - NOVEMBER, 1985

B BW1 THROUGH BW7 MONITORING WELLS INSTALLED BY WOODWARD CLYDE CONSULTANTS, SEPTEMBER, 1983 - JULY, 1984, BW8 - BW14 INSTALLED BY WESTON GEOPHYSICAL CORP AUGUST 1985 - NOVEMBER 1985

G W. R. GRACE/CRYOVAC DIVISION MONITORING WELLS INSTALLED BY GEOENVIRONMENTAL CONSULTANTS, JUNE, 1983 - JANUARY, 1986

IUS INTERSTATE UNIFORM MONITORING WELLS INSTALLED BY ENVIRONMENTAL RESEARCH AND TECHNOLOGY NOVEMBER, 1983 - MARCH, 1984

NE, OL, AB NE1-NE3, OL1 - OL5, AND AB-1 EPA MONITORING WELLS INSTALLED BY EBASCO SERVICES NOVEMBER 1987 - DECEMBER 1987

UC4-UC22 UNIFIRST CORP. MONITORING WELLS INSTALLED BY ERT NOVEMBER 1986 - OCTOBER 1987 WELLS SAMPLED BY ERT AND EPA DECEMBER 1986 - FEBRUARY 1988

3. HORIZONTAL AND VERTICAL CONTROL, MONITORING WELLS AND ALL SAMPLE LOCATIONS AS FIELD LOCATED BY C.T. MALE ASSOCIATES, P.C. IN FEBRUARY, 1988.

LEGEND:

- MONITORING WELL SCREENED IN OVERBURDEN
- MONITORING WELL SCREENED IN BEDROCK
- INDUSTRIAL WATER WELL SCREENED IN OVERBURDEN
- WATER WELL FINISHED IN BEDROCK
- ABANDONED WATER WELL SCREENED IN OVERBURDEN
- MONITORING WELL SCREENED IN BEDROCK AND OVERBURDEN
- SIX INCH WELL OPEN IN ROCK; UC22 IS AN 8-INCH WELL

* ASTERISK INDICATES MULTIPOINT WELLS (i.e., UC10*)

TOTAL VOLATILE ORGANICS (TVOs)

10,000 + ppb

1,000 + ppb

501 - 1,000 ppb

101 - 500 ppb

11 - 100 ppb

0 - 10 ppb

NOT DETECTED

OVERBURDEN

BEDROCK

OVERBURDEN + BEDROCK

U.S. ENVIRONMENTAL PROTECTION AGENCY

WELLS G&H SITE
WOBURN, MASSACHUSETTS

VOLATILE ORGANIC CONCENTRATIONS
IN GROUNDWATER
1987

DRAWING NO: PLATE 2

SCALE: AS SHOWN

DATE: JULY 1988

EBASCO SERVICES INCORPORATED

Wells G&H
19.7